The CImg Library

1.2.8

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1 Main Page

This is the reference documentation of `the CImg Library`, the C++ template image processing library. This documentation have been generated using the tool `doxygen`. It contains a detailed description of all classes and functions of the CImg Library. If you have downloaded the CImg package, you actually have a local copy of these pages in the `CImg/documentation/reference/` directory.

Use the menu above to navigate through the documentation pages. As a first step, you may look at the list of `available modules`.

A complete PDF version of this reference documentation is `available here` for off-line reading.

A partial translation in Chinese is `available here`.

You may be interested also in the `presentation slides` presenting an overview of the CImg Library capabilities.

2 Module Documentation

2.1 CImg Library Overview

The **CImg Library** is an image processing library, designed for C++ programmers. It provides useful classes and functions to load/save, display and process various types of images.

2.1.1 Library structure

The CImg Library consists in a **single header file** CImg.h providing a set of C++ template classes that can be used in your own sources, to load/save, process and display images or list of images. Very portable (Unix/X11,Windows, MacOS X, FreeBSD,..), efficient, simple to use, it's a pleasant toolkit for coding image processing stuffs in C++.

The header file CImg.h contains all the classes and functions that compose the library itself. This is one originality of the CImg Library. This particularly means that :

- No pre-compilation of the library is needed, since the compilation of the CImg functions is done at the same time as the compilation of your own C++ code.
- No complex dependencies have to be handled : Just include the CImg.h file, and you get a working C++ image processing toolkit.

- The compilation is done on the fly : only CImg functionalities really used by your program are compiled and appear in the compiled executable program. This leads to very compact code, without any unused stuffs.
- Class members and functions are inlined, leading to better performance during the program execution.

The CImg Library is structured as follows :

- All library classes and functions are defined in the namespace **cimg_library** (p. 19). This namespace encapsulates the library functionalities and avoid any class name collision that could happen with other includes. Generally, one uses this namespace as a default namespace :

```
#include "CImg.h"
using namespace cimg_library;
...
```

- The namespace **cimg_library::cimg** (p. 20) defines a set of *low-level* functions and variables used by the library. Documented functions in this namespace can be safely used in your own program. But, **never** use the **cimg_library::cimg** (p. 20) namespace as a default namespace, since it contains functions whose names are already defined in the standard C/C++ library.

- The class **cimg_library::CImg** (p. 25)<T> represents images up to 4-dimensions wide, containing pixels of type `T` (template parameter). This is actually the main class of the library.

- The class **cimg_library::CImgList** (p. 145)<T> represents lists of cimg_library::CImg<T> images. It can be used for instance to store different frames of an image sequence.

- The class **cimg_library::CImgDisplay** (p. 135) is able to display images or image lists into graphical display windows. As you may guess, the code of this class is highly system-dependent but this is transparent for the programmer, as environment variables are automatically set by the CImg library (see also **Setting Environment Variables** (p. 7)).

- The class **cimg_library::CImgException** (p. 143) (and its subclasses) are used by the library to throw exceptions when errors occur. Those exceptions can be catched with a bloc `try { ..} catch (CImgException) { .. }`. Subclasses define precisely the type of encountered errors.

Knowing these four classes is **enough** to get benefit of the CImg Library functionalities.

2.1.2 CImg version of "Hello world".

Below is a very simple code that creates a "Hello World" image. This shows you basically how a CImg program looks like.

```
#include "CImg.h"
using namespace cimg_library;

int main() {
  CImg<unsigned char> img(640,400,1,3);        // Define a 640x400 color image with 8 bits per color com
  img.fill(0);                                 // Set pixel values to 0 (color : black)
  unsigned char purple[] = { 255,0,255 };      // Define a purple color
  img.draw_text("Hello World",100,100,purple); // Draw a purple "Hello world" at coordinates (100,100).
  img.display("My first CImg code");           // Display the image in a display window.
  return 0;
}
```

Which can be also written in a more compact way as :

```
#include "CImg.h"
using namespace cimg_library;

int main() {
  const unsigned char purple[] = { 255,0,255 };
  CImg<unsigned char>(640,400,1,3,0).draw_text("Hello World",100,100,purple).display("My first CImg code
  return 0;
}
```

Generally, you can write very small code that performs complex image processing tasks. The CImg Library is very simple to use and provide a lot of interesting algorithms for image manipulation.

2.1.3 How to compile ?

The CImg library is a very light and user-friendly library : only standard system libraries are used. It avoid to handle complex dependancies and problems with library compatibility. The only thing you need is a (quite modern) C++ compiler :

- **Microsoft Visual C++ 6.0, Visual Studio.NET and Visual Express Edition** : Use project files and solution files provided in the CImg Library package (directory 'compilation/') to see how it works.
- **Intel ICL compiler** : Use the following command to compile a CImg-based program with ICL :

  ```
  icl /Ox hello_world.cpp user32.lib gdi32.lib
  ```

- **g++ (MingW windows version)** : Use the following command to compile a CImg-based program with g++, on Windows :

  ```
  g++ -o hello_word.exe hello_word.cpp -O2 -lgdi32
  ```

- **g++ (Linux version)** : Use the following command to compile a CImg-based program with g++, on Linux :

  ```
  g++ -o hello_word.exe hello_world.cpp -O2 -L/usr/X11R6/lib -lm -lpthread -lX11
  ```

- **g++ (Solaris version)** : Use the following command to compile a CImg-based program with g++, on Solaris :

  ```
  g++ -o hello_word.exe hello_world.cpp -O2 -lm -lpthread -R/usr/X11R6/lib -lrt -lnsl -lsocket
  ```

- **g++ (Mac OS X version)** : Use the following command to compile a CImg-based program with g++, on Mac OS X :

  ```
  g++ -o hello_word.exe hello_world.cpp -O2 -lm -lpthread -L/usr/X11R6/lib -lm -lpthread -lX11
  ```

- **Dev-Cpp** : Use the project file provided in the CImg library package to see how it works.

If you are using another compilers and encounter problems, please `write me` since maintaining compatibility is one of the priority of the CImg Library. Nevertheless, old compilers that does not respect the C++ norm will not support the CImg Library.

2.1.4 What's next ?

If you are ready to get more, and to start writing more serious programs with CImg, you are invited to go to the **Tutorial : Getting Started.** (p. 9) section.

2.2 FAQ : Frequently Asked Questions.

2.2.1 FAQ Summary

- `General information and availability`
  - `What is the CImg Library ?`
  - `What platforms are supported ?`
  - `How is CImg distributed ?`
  - `What kind of people are concerned by CImg ?`
  - `What are the specificities of the CeCILL license ?`
  - `Who is behind CImg ?`
- `C++ related questions`
  - `What is the level of C++ knowledge needed to use CImg ?`
  - `How to use CImg in my own C++ program ?`
  - `Why is CImg entirely contained in a single header file ?`

2.2.2 1. General information and availability

2.2.2.1 1.1. What is the CImg Library ? The CImg Library is an *open-source C++ toolkit for image processing*.

It mainly consists in a (big) single header file `CImg.h` providing a set of C++ classes and functions that can be used in your own sources, to load/save, manage/process and display generic images. It's actually a very simple and pleasant toolkit for coding image processing stuffs in C++ : Just include the header file *CImg.h*, and you are ready to handle images in your C++ programs.

2.2.2.2 1.2. What platforms are supported ? CImg has been designed with *portability* in mind. It is regularly tested on different architectures and compilers, and should also work on any decent OS having a decent C++ compiler. Before each release, the CImg Library is compiled under these different configurations :

- PC Linux 32 bits, with g++.
- PC Windows 32 bits, with Visual C++ 6.0.
- PC Windows 32 bits, with Visual C++ Express Edition.
- Sun SPARC Solaris 32 bits, with g++.
- Mac PPC with OS X and g++.

CImg has a minimal number of dependencies. In its minimal version, it can be compiled only with standard C++ headers. Anyway, it has interesting extension capabilities and can use external libraries to perform specific tasks more efficiently (Fourier Transform computation using FFTW for instance).

2.2.2.3 1.3. How is CImg distributed ? The CImg Library is freely distributed as a complete .zip compressed package, hosted at the `Sourceforge servers`.

The package is distributed under the `CeCILL license`.

This package contains :

- The main library file `CImg.h` (C++ header file).
- Several C++ source code showing `examples of using CImg`.
- A complete library documentation, in `HTML` and `PDF` formats.
- Additional `library plug-ins` that can be used to extend library capabilities for specific uses.

The CImg Library is a quite lightweight library which is easy to maintain (due to its particular structure), and thus has a fast rythm of release. A new version of the CImg package is released approximately every three months.

2.2.2.4 1.4. What kind of people are concerned by CImg ? The CImg library is an *image processing* library, primarily intended for computer scientists or students working in the fields of image processing or computer vision, and knowing bases of C++. As the library is handy and really easy to use, it can be also used by any programmer needing occasional tools for dealing with images in C++, since there are no standard library yet for this purpose.

2.2.2.5 1.5. What are the specificities of the CeCILL license ? The `CeCILL license` governs the use of the CImg Library. This is an *open-source* license which gives you rights to access, use, modify and redistribute the source code, under certains conditions. There are two different variants of the CeCILL license used in CImg (namely `CeCILL` and `CeCILL-C`, all open-source), corresponding to different constraints on the source files :

- The `CeCILL-C` license is the most permissive one, close to the *GNU LGPL license*, and *applies* **only** *on the main library file* `CImg.h`. Basically, this license allows to use `CImg.h` in a closed-source product without forcing you to redistribute the entire software source code. Anyway, if one modifies the `CImg.h` source file, one has to redistribute the modified version of the file that must be governed by the same `CeCILL-C` license.

- The `CeCILL` license applies to all other files (source examples, plug-ins and documentation) of the CImg Library package, and is close (even *compatible*) with the *GNU GPL license*. It *does not allow* the use of these files in closed-source products.

You are invited to read the complete descriptions of the the `CeCILL-C` and `CeCILL` licenses before releasing a software based on the CImg Library.

2.2.2.6 1.6. Who is behind CImg ? CImg has been started by `David Tschumperle` at the beginning of his PhD thesis, in October 1999. He is still the main coordinator of the project. Since the first release at Sourceforge, a growing number of contributors has appeared. Due to the very simple and compact form of the library, submitting a contribution is quite easy and can be fastly integrated into the supported releases. List of contributors can be found on the front page.

2.2.3 2. C++ related questions

2.2.3.1 2.1 What is the level of C++ knowledge needed to use CImg ? The CImg Library has been designed using C++ templates and object-oriented programming techniques, but in a very accessible level. There are only public classes without any derivation (just like C structures) and there is at most one template parameter for each CImg class (defining the pixel type of the images). The design is simple but clean, making the library accessible even for non professional C++ programmers, while proposing strong extension capabilities for C++ experts.

2.2.3.2 2.2 How to use CImg in my own C++ program ? Basically, you need to add these two lines in your C++ source code, in order to be able to work with CImg images :

```
#include "CImg.h"
using namespace cimg_library;
```

2.2.3.3 2.3 Why is CImg entirely contained in a single header file ? People are often surprised to see that the complete code of the library is contained in a single (big) C++ header file `CImg.h`. There are good practical and technical reasons to do that. Some arguments are listed below to justify this approach, so (I hope) you won't think this is a awkwardly C++ design of the CImg library :

- First, the library is based on *template datatypes* (images with generic pixel type), meaning that the programmer is free to decide what type of image he instanciates in his code. Even if there are roughly a limited number of fully supported types (basically, the "atomic" types of C++ : *unsigned char, int, float, ...*), this is *not imaginable* to pre-compile the library classes and functions for *all possible atomic datatypes*, since many functions and methods can have two or three arguments having different template parameters. This really means *a huge number* of possible combinations. The size of the object binary file generated to cover all possible cases would be just *colossal*. Is the STL library a pre-compiled one ? No, CImg neither. CImg is not using a classical *.cpp* and *.h* mechanism, just like the STL. Architectures of C++ *template-based* libraries are somewhat special in this sense. This is a proven technical fact.

- Second, why CImg does not have several header files, just like the STL does (one for each class for instance) ? This would be possible of course. There are only 4 classes in CImg, the two most important being *CImg<T>* and *CImgList<T>* representing respectively an image and a collection of images. But contrary to the STL library, these two CImg classes are strongly *inter-dependent*. All CImg algorithms are actually not defined as separate functions acting on containers (as the STL does with his header <algorithm>), but are directly methods of the image and image collection classes. This inter-dependence practically means that you will undoubtly need these two main classes at the same time if you are using CImg. If they were defined in separate header files, you would be forced to include both of them. What is the gain then ? No gain.

  Concerning the two other classes : You can disable the third most important class *CImgDisplay* of the CImg library, by setting the compilation macro *cimg_display_type* to 0, avoiding thus to compile this class if you don't use display capabilities of CImg in your code. But to be honest, this is a quite small class and doing this doesn't save much compilation time. The last and fourth class is *CImgException*, which is only few lines long and is obviously required in almost all methods of CImg. Including this one is *mandatory*.

  As a consequence, having a single header file instead of several ones is just a way for you to avoid including all of them, without any consequences on compilation time. This is both good technical and practical reasons to do like this.

- Third, having a single header file has plenty of advantages : Simplicity for the user, and for the developers (maintenance is in fact easier). Look at the *CImg.h* file, it looks like a mess at a first

glance, but it is in fact very well organized and structured. Finding pieces of code in CImg functions or methods is particularly easy and fast. Also, how about the fact that library installation problems just disappear ? Just bring *CImg.h* with you, put it in your source directory, and the library is ready to go !

I admit the compilation time of CImg-based programs can be sometime long, but don't think that it is due to the fact that you are using a single header file. Using several header files wouldn't arrange anything since you would need all of them. Having a pre-compiled library object would be the only solution to speed up compilation time, but it is not possible at all, due to the too much generic nature of the library. Think seriously about it, and if you have a better solution to provide, let me know so we can discuss about it.

2.3 Setting Environment Variables

The CImg library is a multiplatform library, working on a wide variety of systems. This implies the existence of some *environment variables* that must be correctly defined depending on your current system. Most of the time, the CImg Library defines these variables automatically (for popular systems). Anyway, if your system is not recognized, you will have to set the environment variables by hand. Here is a quick explanations of environment variables.

Setting the environment variables is done with the `define` keyword. This setting must be done *before including the file CImg.h* in your source code. For instance, defining the environment variable `cimg_display_type` would be done like this :

```
#define cimg_display_type 0
#include "CImg.h"
...
```

Here are the different environment variables used by the CImg Library :

- `cimg_OS` : This variable defines the type of your Operating System. It can be set to **1** (*Unix*), **2** (*Windows*), or **0** (*Other configuration*). It should be actually auto-detected by the CImg library. If this is not the case (`cimg_OS=0`), you will probably have to tune the environment variables described below.

- `cimg_display_type` : This variable defines the type of graphical library used to display images in windows. It can be set to 0 (no display library available), **1** (X11-based display) or **2** (Windows-GDI display). If you are running on a system without X11 or Windows-GDI ability, please set this variable to `0`. This will disable the display support, since the CImg Library doesn't contain the necessary code to display images on systems other than X11 or Windows GDI.

- `cimg_color_terminal` : This variable tells the library if the system terminal has VT100 color capabilities. It can be *defined* or *not defined*. Define this variable to get colored output on your terminal, when using the CImg Library.

- `cimg_debug` : This variable defines the level of run-time debug messages that will be displayed by the CImg Library. It can be set to 0 (no debug messages), 1 (normal debug messages displayed on standard error), 2 (normal debug messages displayed in modal windows, which is the default value), or 3 (high debug messages). Note that setting this value to 3 may slow down your program since more debug tests are made by the library (particularly to check if pixel access is made outside image boundaries). See also CImgException to better understand how debug messages are working.

- `cimg_convert_path` : This variables tells the library where the ImageMagick's *convert* tool is located. Setting this variable should not be necessary if ImageMagick is installed on a standard directory, or if *convert* is in your system PATH variable. This macro should be defined only if the ImageMagick's *convert* tool is not found automatically, when trying to read compressed image format (GIF,PNG,...). See also cimg_library::CImg::get_load_convert() and cimg_library::CImg::save_convert() for more informations.

- `cimg_temporary_path` : This variable tells the library where it can find a directory to store temporary files. Setting this variable should not be necessary if you are running on a standard system. This macro should be defined only when troubles are encountered when trying to read compressed image format (GIF,PNG,...). See also cimg_library::CImg::get_load_convert() and cimg_library::CImg::save_convert() for more informations.

- `cimg_plugin` : This variable tells the library to use a plugin file to add features to the CImg<T> class. Define it with the path of your plugin file, if you want to add member functions to the CImg<T> class, without having to modify directly the `"CImg.h"` file. An include of the plugin file is performed in the CImg<T> class. If `cimg_plugin` if not specified (default), no include is done.

- `cimglist_plugin` : Same as `cimg_plugin`, but to add features to the CImgList<T> class.

- `cimgdisplay_plugin` : Same as `cimg_plugin`, but to add features to the CImgDisplay<T> class.

All these compilation variables can be checked, using the function **cimg_library::cimg::info()** (p. 22), which displays a list of the different configuration variables and their values on the standard error output.

2.4 How to use CImg library with Visual C++ 2005 Express Edition ?.

2.4.1 How to use CImg library with Visual C++ 2005 Express Edition ?

This section has been written by Vincent Garcia and Alexandre Fournier from I3S/Sophia_Antipolis.

- Download CImg library
- Download and install Visual C++ 2005 Express Edition
- Download and install Microsoft Windows SDK
- Configure Visual C++ to take into account Microsoft SDK
  - 1. Go to menu "Tools → options"
  - 2. Select option "Projects and Solutions → VC++ Directories"
  - 3. In the select liste "Show directories for", choose "include files", and add C: Files Platform SDK (adapt if needed)
  - 4. In the select liste "Show directories for", choose "library files", and add C: Files Platform SDK (adapt if needed) Edit file C: Files Visual Studio 8\VC\VCProjectDefaults\corewin_express.vsprops (adapt if needed)
  - 6. 7. Remplace the line AdditionalDependencies="kernel32.lib" /> by AdditionalDependencies="kernel32.lib user32.lib gdi32.lib winspool.lib comdlg32.lib advapi32.lib shell32.lib ole32.lib oleaut32.lib uuid.lib" />
- Restart Visual C++
- Import CImg library in your main file

2.5 Tutorial : Getting Started.

Let's start to write our first program to get the idea. This will demonstrate how to load and create images, as well as handle image display and mouse events. Assume we want to load a color image `lena.jpg`, smooth it, display it in a windows, and enter an event loop so that clicking a point in the image will draw the (R,G,B) intensity profiles of the corresponding image line (in another window). Yes, that sounds quite complex for a first code, but don't worry, it will be very simple using the CImg library ! Well, just look at the code below, it does the task :

```
#include "CImg.h"
using namespace cimg_library;

int main() {
  CImg<unsigned char> image("lena.jpg"), visu(500,400,1,3,0);
  const unsigned char red[] = { 255,0,0 }, green[] = { 0,255,0 }, blue[] = { 0,0,255 };
  image.blur(2.5);
  CImgDisplay main_disp(image,"Click a point"), draw_disp(visu,"Intensity profile");
  while (!main_disp.is_closed && !draw_disp.is_closed) {
    main_disp.wait();
    if (main_disp.button && main_disp.mouse_y>=0) {
      const int y = main_disp.mouse_y;
      visu.fill(0).draw_graph(image.get_crop(0,y,0,0,image.dimx()-1,y,0,0),red,1,255,0);
      visu.draw_graph(image.get_crop(0,y,0,1,image.dimx()-1,y,0,1),green,1,255,0);
      visu.draw_graph(image.get_crop(0,y,0,2,image.dimx()-1,y,0,2),blue,1,255,0).display(draw_disp);
      }
    }
  return 0;
}
```

Here is a screenshot of the resulting program :

And here is the detailled explanation of the source, line by line :

```
#include "CImg.h"
```

Include the main and only header file of the CImg library.

```
using namespace cimg_library;
```

Use the library namespace to ease the declarations afterward.

```
int main() {
```

Definition of the main function.

```
CImg<unsigned char> image("lena.jpg"), visu(500,400,1,3,0);
```

Creation of two instances of images of `unsigned char` pixels. The first image `image` is initialized by reading an image file from the disk. Here, `lena.jpg` must be in the same directory than the current program. Note that you must also have installed the *ImageMagick* package in order to be able to read JPG images. The second image `visu` is initialized as a black color image with dimension `dx=500`, `dy=400`, `dz=1` (here, it is a 2D image, not a 3D one), and `dv=3` (each pixel has 3 'vector' channels R,G,B). The last argument in the constructor defines the default value of the pixel values (here `0`, which means that `visu` will be initially black).

```
const unsigned char red[] = { 255,0,0 }, green[] = { 0,255,0 }, blue[] = { 0,0,255 };
```

Definition of three different colors as array of unsigned char. This will be used to draw plots with different colors.

```
image.blur(2.5);
```

Blur the image, with a gaussian blur and a standard variation of 2.5. Note that most of the CImg functions have two versions : one that acts in-place (which is the case of blur), and one that returns the result as a new image (the name of the function begins then with `get_`). In this case, one could have also written `image = image.get_blur(2.5);` (more expensive, since it needs an additional copy operation).

```
CImgDisplay main_disp(image,"Click a point"), draw_disp(visu,"Intensity profile");
```

Creation of two display windows, one for the input image image, and one for the image visu which will be display intensity profiles. By default, CImg displays handles events (mouse,keyboard,..). On Windows, there is a way to create fullscreen displays.

```
while (!main_disp.is_closed && !draw_disp.is_closed) {
```

Enter the event loop, the code will exit when one of the two display windows is closed.

```
main_disp.wait();
```

Wait for an event (mouse, keyboard,..) in the display window `main_disp`.

```
if (main_disp.button && main_disp.mouse_y>=0) {
```

Test if the mouse button has been clicked on the image area. One may distinguish between the 3 different mouse buttons, but in this case it is not necessary

```
const int y = main_disp.mouse_y;
```

Get the image line y-coordinate that has been clicked.

```
visu.fill(0).draw_graph(image.get_crop(0,y,0,0,image.dimx()-1,y,0,0),red,0,256,0);
```

This line illustrates the pipeline property of most of the CImg class functions. The first function `fill(0)` simply sets all pixel values with 0 (i.e. clear the image `visu`). The interesting thing is that it returns a reference to `visu` and then, can be pipelined with the function `draw_graph()` which draws a plot in the image `visu`. The plot data are given by another image (the first argument of `draw_graph()`). In this case, the given image is the red-component of the line y of the original image, retrieved by the function `get_crop()` which returns a sub-image of the image `image`. Remember that images coordinates are 4D (x,y,z,v) and for color images, the R,G,B channels are respectively given by `v=0`, `v=1` and `v=2`.

```
visu.draw_graph(image.get_crop(0,y,0,1,image.dimx()-1,y,0,1),green,0,256,0);
```

Plot the intensity profile for the green channel of the clicked line.

```
visu.draw_graph(image.get_crop(0,y,0,2,image.dimx()-1,y,0,2),blue,0,256,0).display(draw_disp);
```

Same thing for the blue channel. Note how the function (which return a reference to `visu`) is pipelined with the function `display()` that just paints the image visu in the corresponding display window.

```
...till the end
```

I don't think you need more explanations !

As you have noticed, the CImg library allows to write very small and intuitive code. Note also that this source will perfectly work on Unix and Windows systems. Take also a look to the examples provided in the CImg package (directory `examples/`). It will show you how CImg-based code can be surprisingly small. Moreover, there is surely one example close to what you want to do. A good start will be to look at the file `CImg_demo.cpp` which contains small and various examples of what you can do with the CImg Library. All CImg classes are used in this source, and the code can be easily modified to see what happens.

2.6 Using Drawing Functions.

2.6.1 Using Drawing Functions.

This section tells more about drawing features in CImg images. Drawing functions list can be found in `the CImg functions list` (section **Drawing** Functions), and are all defined on a common basis. Here are the important points to understand before using drawing functions :

- Drawing is performed on the instance image. Drawing functions parameters are defined as *const* variables and return a reference to the current instance `(*this)`, so that drawing functions can be pipelined (see examples below). Drawing is usually done in 2D color images but can be performed in 3D images with any vector-valued dimension, and with any possible pixel type.

- A color parameter is always needed to draw features in an image. The color must be defined as a C-style array whose dimension is at least

2.7 Using Image Loops.

The CImg Library provides different macros that define useful iterative loops over an image. Basically, it can be used to replace one or several `for(..)` instructions, but it also proposes interesting extensions to classical loops. Below is a list of all existing loop macros, classified in four different categories :

2.7.1 Loops over the pixel buffer

Loops over the pixel buffer are really basic loops that iterate a pointer on the pixel data buffer of a **`cimg_library::CImg`** `(p. 25)` image. Two macros are defined for this purpose :

- **cimg_for(img,ptr,T)** : This macro loops over the pixel data buffer of the image `img`, using a pointer `T* ptr`, starting from the end of the buffer (last pixel) till the beginning of the buffer (first pixel).
  - `img` must be a (non empty) **`cimg_library::CImg`** `(p. 25)` image of pixels `T`.
  - `ptr` is a pointer of type `T*`. This kind of loop should not appear a lot in your own source code, since this is a low-level loop and many functions of the CImg class may be used instead. Here is an example of use :

```
CImg<float> img(320,200);
cimg_for(img,ptr,float) { *ptr=0; }      // Equivalent to 'img.fill(0);'
```

- **cimg_foroff(img,off)** : This macro loops over the pixel data buffer of the image `img`, using an offset , starting from the beginning of the buffer (first pixel, `off=0`) till the end of the buffer (last pixel value, `off = img.size()-1`).
  - `img` must be a (non empty) cimg_library::CImg<T> image of pixels `T`.
  - `off` is an inner-loop variable, only defined inside the scope of the loop.

Here is an example of use :

```
CImg<float> img(320,200);
cimg_foroff(img,off) { img[off]=0; }  // Equivalent to 'img.fill(0);'
```

2.7.2 Loops over image dimensions

The following loops are probably the most used loops in image processing programs. They allow to loop over the image along one or several dimensions, along a raster scan course. Here is the list of such loop macros for a single dimension :

- **cimg_forX(img,x)** : equivalent to : `for (int x=0; x<img.dimx(); x++).`
- **cimg_forY(img,y)** : equivalent to : `for (int y=0; y<img.dimy(); y++).`
- **cimg_forZ(img,z)** : equivalent to : `for (int z=0; z<img.dimz(); z++).`
- **cimg_forV(img,v)** : equivalent to : `for (int v=0; v<img.dimv(); v++).`

Combinations of these macros are also defined as other loop macros, allowing to loop directly over 2D, 3D or 4D images :

- **cimg_forXY(img,x,y)** : equivalent to : `cimg_forY(img,y) cimg_forX(img,x).`
- **cimg_forXZ(img,x,z)** : equivalent to : `cimg_forZ(img,z) cimg_forX(img,x).`
- **cimg_forYZ(img,y,z)** : equivalent to : `cimg_forZ(img,z) cimg_forY(img,y).`
- **cimg_forXV(img,x,v)** : equivalent to : `cimg_forV(img,v) cimg_forX(img,x).`
- **cimg_forYV(img,y,v)** : equivalent to : `cimg_forV(img,v) cimg_forY(img,y).`
- **cimg_forZV(img,z,v)** : equivalent to : `cimg_forV(img,v) cimg_forZ(img,z).`
- **cimg_forXYZ(img,x,y,z)** : equivalent to : `cimg_forZ(img,z) cimg_forXY(img,x,y).`
- **cimg_forXYV(img,x,y,v)** : equivalent to : `cimg_forV(img,v) cimg_forXY(img,x,y).`
- **cimg_forXZV(img,x,z,v)** : equivalent to : `cimg_forV(img,v) cimg_forXZ(img,x,z).`
- **cimg_forYZV(img,y,z,v)** : equivalent to : `cimg_forV(img,v) cimg_forYZ(img,y,z).`
- **cimg_forXYZV(img,x,y,z,v)** : equivalent to : `cimg_forV(img,v) cimg_forXYZ(img,x,y,z).`
- For all these loops, `x`,`y`,`z` and `v` are inner-defined variables only visible inside the scope of the loop. They don't have to be defined before the call of the macro.

- `img` must be a (non empty) **cimg_library::CImg** (p. 25) image.

Here is an example of use that creates an image with a smooth color gradient :

```
CImg<unsigned char> img(256,256,1,3);       // Define a 256x256 color image
cimg_forXYV(img,x,y,v) { img(x,y,v) = (x+y)*(v+1)/6; }
img.display("Color gradient");
```

2.7.3 Loops over interior regions and borders.

Similar macros are also defined to loop only on the border of an image, or inside the image (excluding the border). The border may be several pixel wide :

- **cimg_for_insideX(img,x,n)** : Loop along the x-axis, except for pixels inside a border of `n` pixels wide.
- **cimg_for_insideY(img,y,n)** : Loop along the y-axis, except for pixels inside a border of `n` pixels wide.
- **cimg_for_insideZ(img,z,n)** : Loop along the z-axis, except for pixels inside a border of `n` pixels wide.
- **cimg_for_insideV(img,v,n)** : Loop along the v-axis, except for pixels inside a border of `n` pixels wide.
- **cimg_for_insideXY(img,x,y,n)** : Loop along the (x,y)-axes, excepted for pixels inside a border of `n` pixels wide.
- **cimg_for_insideXYZ(img,x,y,z,n)** : Loop along the (x,y,z)-axes, excepted for pixels inside a border of `n` pixels wide.

And also :

- **cimg_for_borderX(img,x,n)** : Loop along the x-axis, only for pixels inside a border of `n` pixels wide.
- **cimg_for_borderY(img,y,n)** : Loop along the y-axis, only for pixels inside a border of `n` pixels wide.
- **cimg_for_borderZ(img,z,n)** : Loop along the z-axis, only for pixels inside a border of `n` pixels wide.
- **cimg_for_borderV(img,v,n)** : Loop along the z-axis, only for pixels inside a border of `n` pixels wide.
- **cimg_for_borderXY(img,x,y,n)** : Loop along the (x,y)-axes, only for pixels inside a border of `n` pixels wide.
- **cimg_for_borderXYZ(img,x,y,z,n)** : Loop along the (x,y,z)-axes, only for pixels inside a border of `n` pixels wide.

- For all these loops, `x`,`y`,`z` and `v` are inner-defined variables only visible inside the scope of the loop. They don't have to be defined before the call of the macro.
- `img` must be a (non empty) **cimg_library::CImg** (p. 25) image.

- The constant n stands for the size of the border.

Here is an example of use, to create a 2d grayscale image with two different intensity gradients :

```
CImg<> img(256,256);
cimg_for_insideXY(img,x,y,50) img(x,y) = x+y;
cimg_for_borderXY(img,x,y,50) img(x,y) = x-y;
img.display();
```

2.7.4 Loops using neighborhoods.

Inside an image loop, it is often useful to get values of neighborhood pixels of the current pixel at the loop location. The CImg Library provides a very smart and fast mechanism for this purpose, with the definition of several loop macros that remember the neighborhood values of the pixels. The use of these macros can highly optimize your code, and also simplify your program.

2.7.4.1 Neighborhood-based loops for 2D images For 2D images, the neighborhood-based loop macros are :

- **cimg_for2x2(img,x,y,z,v,I)** : Loop along the (x,y)-axes using a centered 2x2 neighborhood.
- **cimg_for3x3(img,x,y,z,v,I)** : Loop along the (x,y)-axes using a centered 3x3 neighborhood.
- **cimg_for4x4(img,x,y,z,v,I)** : Loop along the (x,y)-axes using a centered 4x4 neighborhood.
- **cimg_for5x5(img,x,y,z,v,I)** : Loop along the (x,y)-axes using a centered 5x5 neighborhood.

For all these loops, x and y are inner-defined variables only visible inside the scope of the loop. They don't have to be defined before the call of the macro. img is a non empty CImg<T> image. z and v are constants that define on which image slice and vector channel the loop must apply (usually both 0 for grayscale 2D images). Finally, I is the 2x2, 3x3, 4x4 or 5x5 neighborhood that will be updated with the correct pixel values during the loop (see **Defining neighborhoods** (p. 14)).

2.7.4.2 Neighborhood-based loops for 3D images For 3D images, the neighborhood-based loop macros are :

- **cimg_for2x2x2(img,x,y,z,v,I)** : Loop along the (x,y,z)-axes using a centered 2x2x2 neighborhood.
- **cimg_for3x3x3(img,x,y,z,v,I)** : Loop along the (x,y,z)-axes using a centered 3x3x3 neighborhood.

For all these loops, x, y and z are inner-defined variables only visible inside the scope of the loop. They don't have to be defined before the call of the macro. img is a non empty CImg<T> image. v is a constant that defines on which image channel the loop must apply (usually 0 for grayscale 3D images). Finally, I is the 2x2x2 or 3x3x3 neighborhood that will be updated with the correct pixel values during the loop (see **Defining neighborhoods** (p. 14)).

2.7.4.3 Defining neighborhoods The CImg library defines a neighborhood as a set of named *variables* or *references*, declared using specific CImg macros :

- **CImg_2x2(I,type)** : Define a 2x2 neighborhood named I, of type type.
- **CImg_3x3(I,type)** : Define a 3x3 neighborhood named I, of type type.

- **CImg_4x4(I,type)** : Define a 4x4 neighborhood named `I`, of type `type`.
- **CImg_5x5(I,type)** : Define a 5x5 neighborhood named `I`, of type `type`.
- **CImg_2x2x2(I,type)** : Define a 2x2x2 neighborhood named `I`, of type `type`.
- **CImg_3x3x3(I,type)** : Define a 3x3x3 neighborhood named `I`, of type `type`.

Actually, `I` is a *generic name* for the neighborhood. In fact, these macros declare a *set* of new variables. For instance, defining a 3x3 neighborhood `CImg_3x3(I,float)` declares 9 different float variables `Ipp`,`Icp`,`Inp`,`Ipc`,`Icc`,`Inc`,`Ipn`,`Icn`,`Inn` which correspond to each pixel value of a 3x3 neighborhood. Variable indices are `p`,`c` or `n`, and stand respectively for *'previous'*, *'current'* and *'next'*. First indice denotes the `x-axis`, second indice denotes the `y-axis`. Then, the names of the variables are directly related to the position of the corresponding pixels in the neighborhood. For 3D neighborhoods, a third indice denotes the `z-axis`. Then, inside a neighborhood loop, you will have the following equivalence :

- `Ipp = img(x-1,y-1)`
- `Icn = img(x,y+1)`
- `Inp = img(x+1,y-1)`
- `Inpc = img(x+1,y-1,z)`
- `Ippn = img(x-1,y-1,z+1)`
- and so on...

For bigger neighborhoods, such as 4x4 or 5x5 neighborhoods, two additionnal indices are introduced : `a` (stands for *'after'*) and `b` (stands for *'before'*), so that :

- `Ibb = img(x-2,y-2)`
- `Ina = img(x+1,y+2)`
- and so on...

The value of a neighborhood pixel outside the image range (image border problem) is automatically set to the same values than the nearest valid pixel in the image (this is also called the *Neumann border condition*).

2.7.4.4 Neighborhood as a reference It is also possible to define neighborhood variables as references to classical C-arrays or CImg<T> images, instead of allocating new variables. This is done by adding `_ref` to the macro names used for the neighborhood definition :

- **CImg_2x2_ref(I,type,tab)** : Define a 2x2 neighborhood named `I`, of type `type`, as a reference to `tab`.
- **CImg_3x3_ref(I,type,tab)** : Define a 3x3 neighborhood named `I`, of type `type`, as a reference to `tab`.
- **CImg_4x4_ref(I,type,tab)** : Define a 4x4 neighborhood named `I`, of type `type`, as a reference to `tab`.
- **CImg_5x5_ref(I,type,tab)** : Define a 5x5 neighborhood named `I`, of type `type`, as a reference to `tab`.

- **CImg_2x2x2_ref(I,type,tab)** : Define a 2x2x2 neighborhood named `I`, of type `type`, as a reference to `tab`.
- **CImg_3x3x3_ref(I,type,tab)** : Define a 3x3x3 neighborhood named `I`, of type `type`, as a reference to `tab`.

`tab` can be a one-dimensionnal C-style array, or a non empty `CImg<T>` image. Both objects must have same sizes as the considered neighborhoods.

2.7.4.5 Example codes More than a long discussion, the above example will demonstrate how to compute the gradient norm of a 3D volume using the `cimg_for3x3x3()` loop macro :

```
CImg<float> volume("IRM.hdr");        // Load an IRM volume from an Analyze7.5 file
CImg_3x3x3(I,float);                  // Define a 3x3x3 neighborhood
CImg<float> gradnorm(volume);         // Create an image with same size as 'volume'
cimg_for3x3x3(volume,x,y,z,0,I) {     // Loop over the volume, using the neighborhood I
  const float ix = 0.5f*(Incc-Ipcc);  // Compute the derivative along the x-axis.
  const float iy = 0.5f*(Icnc-Icpc);  // Compute the derivative along the y-axis.
  const float iz = 0.5f*(Iccn-Iccp);  // Compute the derivative along the z-axis.
  gradnorm(x,y,z) = std::sqrt(ix*ix+iy*iy+iz*iz);  // Set the gradient norm in the destination image
}
gradnorm.display("Gradient norm");
```

And the following example shows how to deal with neighborhood references to blur a color image by averaging pixel values on a 5x5 neighborhood.

```
CImg<unsigned char> src("image_color.jpg"), dest(src,false), neighbor(5,5);  // Image definitions.
typedef unsigned char uchar;             // Avoid space in the second parameter of the macro CImg_5x5x1
CImg_5x5_ref(N,uchar,neighbor);          // Define a 5x5 neighborhood as a reference to the 5x5 image ne
cimg_forV(src,k)                         // Standard loop on color channels
   cimg_for5x5(src,x,y,0,k,N)            // 5x5 neighborhood loop.
     dest(x,y,k) = neighbor.sum()/(5*5); // Averaging pixels to filter the color image.
CImgList<unsigned char> visu(src,dest);
visu.display("Original + Filtered");     // Display both original and filtered image.
```

Note that in this example, we didn't use directly the variables Nbb,Nbp,..,Ncc,... since there are only references to the neighborhood image `neighbor`. We rather used a member function of `neighbor`.

As you can see, explaining the use of the CImg neighborhood macros is actually more difficult than using them !

2.8 Using Display Windows.

When opening a display window, you can choose the way the pixel values will be normalized before being displayed on the screen. Screen displays only support color values between [0,255], and some

When displaying an image into the display window using CImgDisplay::display(), values of the image pixels can be eventually linearly normalized between [0,255] for visualization purposes. This may be useful for instance when displaying `CImg<double>` images with pixel values between [0,1]. The normalization behavior depends on the value of `normalize` which can be either `0`,`1` or `2` :

- `0` : No pixel normalization is performed when displaying an image. This is the fastest process, but you must be sure your displayed image have pixel values inside the range [0,255].
- `1` : Pixel value normalization is done for each new image display. Image pixels are not modified themselves, only displayed pixels are normalized.
- `2` : Pixel value normalization is done for the first image display, then the normalization parameters are kept and used for all the next image displays.

2.9 How pixel data are stored with CImg.

TODO

2.10 Files IO in CImg.

The CImg Library can NATIVELY handle the following file formats :

- RAW : consists in a very simple header (in ascii), then the image data.
- ASC (Ascii)
- HDR (Analyze 7.5)
- INR (Inrimage)
- PPM/PGM (Portable Pixmap)
- BMP (uncompressed)
- PAN (Pandore-5)
- DLM (Matlab ASCII)

If ImageMagick is installed, The CImg Library can save image in formats handled by ImageMagick : JPG, GIF, PNG, TIF,...

2.11 Retrieving Command Line Arguments.

The CImg library offers facilities to retrieve command line arguments in a console-based program, as it is a commonly needed operation. Three macros `cimg_usage()`, `cimg_help()` and `cimg_option()` are defined for this purpose. Using these macros allows to easily retrieve options values from the command line. Invoking the compiled executable with the option `-h` or `-help` will automatically display the program usage, followed by the list of requested options.

2.11.1 The cimg_usage() macro

The macro `cimg_usage(usage)` may be used to describe the program goal and usage. It is generally inserted one time after the `int main(int argc,char **argv)` definition.

Parameters:

usage : A string describing the program goal and usage.

Precondition:

The function where `cimg_usage()` is used must have correctly defined `argc` and `argv` variables.

2.11.2 The cimg_help() macro

The macro `cimg_help(str)` will display the string `str` only if the `-help` or `-help` option are invoked when running the programm.

2.11.3 The cimg_option() macro

The macro `cimg_option(name,default,usage)` may be used to retrieve an option value from the command line.

Parameters:

name : The name of the option to be retrieved from the command line.

default : The default value returned by the macro if no options `name` has been specified when running the program.

usage : A brief explanation of the option. If `usage==0`, the option won't appear on the option list when invoking the executable with options `-h` or `-help` (hidden option).

Returns:

`cimg_option()` returns an object that has the *same type* than the default value `default`. The return value is equal to the one specified on the command line. If no such option have been specified, the return value is equal to the default value `default`. Warning, this can be confusing in some situations (look at the end of the next section).

Precondition:

The function where `cimg_option()` is used must have correctly defined `argc` and `argv` variables.

2.11.4 Example of use

The code below uses the macros `cimg_usage()` and `cimg_option()`. It loads an image, smoothes it an quantifies it with a specified number of values.

```
#include "CImg.h"
using namespace cimg_library;
int main(int argc,char **argv) {
  cimg_usage("Retrieve command line arguments");
  const char* filename = cimg_option("-i","image.gif","Input image file");
  const char* output   = cimg_option("-o",(char*)0,"Output image file");
  const double sigma   = cimg_option("-s",1.0,"Standard variation of the gaussian smoothing");
  const  int nblevels  = cimg_option("-n",16,"Number of quantification levels");
  const bool hidden    = cimg_option("-hidden",false,0);      // This is a hidden option

  CImg<unsigned char> img(filename);
  img.blur(sigma).quantize(nblevels);
  if (output) img.save(output); else img.display("Output image");
  if (hidden) std::fprintf(stderr,"You found me !\n");
  return 0;
}
```

Invoking the corresponding executable with `test -h -hidden -n 20 -i foo.jpg` will display :

```
./test -h -hidden -n 20 -i foo.jpg

test : Retrieve command line arguments (Oct 16 2004, 12:34:26)

 -i       = foo.jpg      : Input image file
 -o       = 0            : Output image file
 -s       = 1            : Standard variation of the gaussian smoothing
 -n       = 20           : Number of quantification levels

You found me !
```

Warning:

As the type of object returned by the macro `cimg_option(option,default,usage)` is defined by the type of `default`, undesired casts may appear when writting code such as :

```
const double sigma = cimg_option("-val",0,"A floating point value");
```

In this case, `sigma` will always be equal to an integer (since the default value `0` is an integer). When passing a float value on the command line, a *float to integer* cast is then done, truncating the given parameter to an integer value (this is surely not a desired behavior). You must specify `0.0` as the default value in this case.

2.11.5 How to learn more about command line options ?

You should take a look at the examples `examples/inrcast.cpp` provided in the CImg Library package. This is a command line based image converter which intensively uses the `cimg_option()` and `cimg_usage()` macros to retrieve command line parameters.

3 Namespace Documentation

3.1 cimg_library Namespace Reference

Namespace that encompasses all classes and functions of the CImg library.

Classes

- struct **CImgException**

  Class which is thrown when an error occured during a CImg library function call.

- struct **CImgDisplay**

  This class represents a window which can display ***CImg*** *(*p. 25*) images and handles mouse and keyboard events.*

- struct **CImg**

  Class representing an image (up to 4 dimensions wide), each pixel being of type `T`.

- struct **CImgList**

  Class representing list of images CImg<T>.

Namespaces

- namespace **cimg**

  Namespace that encompasses low-level *functions and variables of the CImg Library.*

3.1.1 Detailed Description

Namespace that encompasses all classes and functions of the CImg library.

This namespace is defined to avoid functions and class names collisions that could happen with the include of other C++ header files. Anyway, it should not happen often and you should start most of your CImg-based programs with

```
#include "CImg.h"
using namespace cimg_library;
```

to simplify the declaration of CImg Library objects variables afterwards.

3.2 cimg_library::cimg Namespace Reference

Namespace that encompasses *low-level* functions and variables of the CImg Library.

Functions

- void **info** ()

  Print informations about CImg environement variables.

- template<typename tfunc, typename tp, typename tf>
  void **marching_cubes** (const tfunc &func, const float isovalue, const float x0, const float y0, const float z0, const float x1, const float y1, const float z1, const float resx, const float resy, const float resz, **CImgList**< tp > &points, **CImgList**< tf > &primitives, const bool invert_faces)

  Polygonize an implicit function.

- template<typename tfunc, typename tp, typename tf>
  void **marching_squares** (const tfunc &func, const float isovalue, const float x0, const float y0, const float x1, const float y1, const float resx, const float resy, **CImgList**< tp > &points, **CImgList**< tf > &primitives)

  Polygonize an implicit 2D function by the marching squares algorithm.

- bool **endian** ()

  Return `false` *for little endian CPUs (Intel),* `true` *for big endian CPUs (Motorola).*

- unsigned long **time** ()

  Get the value of a system timer with a millisecond precision.

- void **sleep** (const unsigned int milliseconds)

  Sleep for a certain numbers of milliseconds.

- unsigned int **wait** (const unsigned int milliseconds)

  Wait for a certain number of milliseconds since the last call.

- const char * **imagemagick_path** ()

  Return path of the ImageMagick's `convert` *tool.*

- const char * **graphicsmagick_path** ()

  Return path of the GraphicsMagick's `gm` *tool.*

- const char * **medcon_path** ()

  Return path of the `XMedcon` *tool.*

- const char * **temporary_path** ()

  Return path to store temporary files.

- template<typename T>
  T **abs** (const T a)

  Return the absolute value of `a`.

- template<typename t1, typename t2>
  cimg::superset< t1, t2 >::type **min** (const t1 &a, const t2 &b)

  Return the minimum between `a` *and* `b`.

- template<typename t1, typename t2, typename t3>
  cimg::superset2< t1, t2, t3 >::type **min** (const t1 &a, const t2 &b, const t3 &c)

  Return the minimum between `a,b` *and* c.

- template<typename t1, typename t2, typename t3, typename t4>
  cimg::superset3< t1, t2, t3, t4 >::type **min** (const t1 &a, const t2 &b, const t3 &c, const t4 &d)

  Return the minimum between `a,b,c` *and* `d`.

- template<typename t1, typename t2>
  cimg::superset< t1, t2 >::type **max** (const t1 &a, const t2 &b)

  Return the maximum between `a` *and* `b`.

- template<typename t1, typename t2, typename t3>
  cimg::superset2< t1, t2, t3 >::type **max** (const t1 &a, const t2 &b, const t3 &c)

  Return the maximum between `a,b` *and* `c`.

- template<typename t1, typename t2, typename t3, typename t4>
  cimg::superset3< t1, t2, t3, t4 >::type **max** (const t1 &a, const t2 &b, const t3 &c, const t4 &d)

  Return the maximum between `a,b,c` *and* `d`.

- template<typename T>
  T **sign** (const T x)

  Return the sign of `x`.

- template<typename T>
  unsigned long **nearest_pow2** (const T x)

  Return the nearest power of 2 higher than `x`.

- template<typename T>
  T **mod** (const T &x, const T &m)

  Return `x` *modulo* `m` *(generic modulo).*

- template<typename T>
  T **minmod** (const T a, const T b)

  Return minmod(`a,b`*).*

- double **rand** ()

  Return a random variable between [0,1], followin a uniform distribution.

- double **crand** ()

  Return a random variable between [-1,1], following a uniform distribution.

- double **grand** ()

  Return a random variable following a gaussian distribution and a standard deviation of 1.

- double **round** (const double x, const double y, const unsigned int round_type=0)

  Return a rounded number.

- template<typename t>
  int **dialog** (const char *title, const char *msg, const char *button1_txt, const char *button2_txt, const char *button3_txt, const char *button4_txt, const char *button5_txt, const char *button6_txt, const **CImg**< t > &logo, const bool centering=false)

  Display a dialog box, where a user can click standard buttons.

Variables

- const double **valuePI** = 3.14159265358979323846

  Definition of the mathematical constant PI.

3.2.1 Detailed Description

Namespace that encompasses *low-level* functions and variables of the CImg Library.

Most of the functions and variables within this namespace are used by the library for low-level processing. Nevertheless, documented variables and functions of this namespace may be used safely in your own source code.

Warning:

Never write `using namespace` **`cimg_library::cimg`** (p. 20)`;` in your source code, since a lot of functions of the **`cimg`** (p. 20)`::` namespace have prototypes similar to standard C functions defined in the global namespace `::`.

3.2.2 Function Documentation

3.2.2.1 void info ()

Print informations about CImg environement variables.

Printing is done on the standard error output.

3.2.2.2 void cimg_library::cimg::sleep (const unsigned int *milliseconds*)

Sleep for a certain numbers of milliseconds.

This function frees the CPU ressources during the sleeping time. It may be used to temporize your program properly, without wasting CPU time.

See also:

wait(), **time()** (p. 20).

3.2.2.3 unsigned int cimg_library::cimg::wait (const unsigned int *milliseconds*)

Wait for a certain number of milliseconds since the last call.

This function is equivalent to **sleep()** (p. 22) but the waiting time is computed with regard to the last call of wait(). It may be used to temporize your program properly.

See also:

sleep() (p. 22), **time()** (p. 20).

3.2.2.4 const char* cimg_library::cimg::imagemagick_path ()

Return path of the ImageMagick's `convert` tool.

This function is used internally in imagemagick_path, graphicsmagick_path and medcon_path on Windows platforms If you have installed the `ImageMagick package` in a standard directory, this function should return the correct path of the `convert` tool used by the CImg Library to load and save compressed image formats. Conversely, if the `convert` executable is not auto-detected by the function, you can define the macro `cimg_imagemagick_path` with the correct path of the `convert` executable, before including `CImg.h` in your program :

```
#define cimg_imagemagick_path "/users/thatsme/local/bin/convert"
#include "CImg.h"

int main() {
  CImg<> img("my_image.jpg");     // Read a JPEG image file.
  return 0;
}
```

Note that non compressed image formats can be read without installing ImageMagick.

See also:

temporary_path() (p. 24), get_load_imagemagick(), load_imagemagick(), save_imagemagick().

3.2.2.5 const char* cimg_library::cimg::graphicsmagick_path ()

Return path of the GraphicsMagick's `gm` tool.

If you have installed the `GraphicsMagick package` in a standard directory, this function should return the correct path of the `gm` tool used by the CImg Library to load and save compressed image formats. Conversely, if the `gm` executable is not auto-detected by the function, you can define the macro `cimg_graphicsmagick_path` with the correct path of the `gm` executable, before including `CImg.h` in your program :

```
#define cimg_graphicsmagick_path "/users/thatsme/local/bin/gm"
#include "CImg.h"

int main() {
  CImg<> img("my_image.jpg");     // Read a JPEG image file.
  return 0;
}
```

Note that non compressed image formats can be read without installing ImageMagick.

See also:

temporary_path() (p. 24), get_load_imagemagick(), load_imagemagick(), save_imagemagick().

3.2.2.6 const char* cimg_library::cimg::medcon_path ()

Return path of the `XMedcon` tool.

If you have installed the `XMedcon package` in a standard directory, this function should return the correct path of the `medcon` tool used by the CIg Library to load DICOM image formats. Conversely, if the `medcon` executable is not auto-detected by the function, you can define the macro `cimg_medcon_path` with the correct path of the `medcon` executable, before including `CImg.h` in your program :

```
#define cimg_medcon_path "/users/thatsme/local/bin/medcon"
#include "CImg.h"

int main() {
  CImg<> img("my_image.dcm");    // Read a DICOM image file.
  return 0;
}
```

Note that `medcon` is only needed if you want to read DICOM image formats.

See also:

temporary_path() (p. 24), get_load_dicom(), load_dicom().

3.2.2.7 const char* cimg_library::cimg::temporary_path ()

Return path to store temporary files.

If you are running on a standard Unix or Windows system, this function should return a correct path where temporary files can be stored. If such a path is not auto-detected by this function, you can define the macro `cimg_temporary_path` with a correct path, before including `CImg.h` in your program :

```
#define cimg_temporary_path "/users/thatsme/tmp"
#include "CImg.h"

int main() {
  CImg<> img("my_image.jpg");   // Read a JPEG image file (using the defined temporay path).
  return 0;
}
```

A temporary path is necessary to load and save compressed image formats, using `convert` or `medcon`.

See also:

imagemagick_path() (p. 23), get_load_imagemagick(), load_imagemagick(), save_imagemagick(), get_load_dicom(), load_dicom().

3.2.2.8 T cimg_library::cimg::mod (const T & *x*, const T & *m*)

Return `x` modulo `m` (generic modulo).

This modulo function accepts negative and floating-points modulo numbers `m`.

3.2.2.9 T cimg_library::cimg::minmod (const T *a*, const T *b*)

Return minmod(a,b).

The operator minmod(a,b) is defined to be :

- minmod(a,b) = min(a,b), if (a * b)>0.
- minmod(a,b) = 0, if (a * b)<=0

3.2.2.10 int cimg_library::cimg::dialog (const char * *title*, const char * *msg*, const char * *button1_txt*, const char * *button2_txt*, const char * *button3_txt*, const char * *button4_txt*, const char * *button5_txt*, const char * *button6_txt*, const CImg< t > & *logo*, const bool *centering* = false)

Display a dialog box, where a user can click standard buttons.

Up to 6 buttons can be defined in the dialog window. This function returns when a user clicked one of the button or closed the dialog window.

Parameters:

title = Title of the dialog window.

msg = Main message displayed inside the dialog window.

button1_txt = Label of the 1st button.

button2_txt = Label of the 2nd button.

button3_txt = Label of the 3rd button.

button4_txt = Label of the 4th button.

button5_txt = Label of the 5th button.

button6_txt = Label of the 6th button.

logo = Logo image displayed at the left of the main message. This parameter is optional.

centering = Tell to center the dialog window on the screen.

Returns:

The button number (from 0 to 5), or -1 if the dialog window has been closed by the user.

Note:

If a button text is set to 0, then the corresponding button (and the followings) won't appear in the dialog box. At least one button is necessary.

4 Class Documentation

4.1 CImg Struct Template Reference

Class representing an image (up to 4 dimensions wide), each pixel being of type T.

Constructors-Destructor-Copy

- **CImg** ()

  Default constructor.

- ~**CImg** ()

  Destructor.

- **CImg**< T > & **assign** ()

  In-place version of the default constructor.

- **CImg**< T > & **clear** ()

  In-place version of the default constructor.

- **CImg** (const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  Constructs a new image with given size (`dx,dy,dz,dv`*).*

- **CImg**< T > & **assign** (const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  In-place version of the previous constructor.

- **CImg** (const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const T val)

  Construct an image with given size (`dx,dy,dz,dv`*) and with pixel having a default value* `val`*.*

- **CImg**< T > & **assign** (const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const T val)

  In-place version of the previous constructor.

- template<typename t>
  CImg (const t *const data_buffer, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1, const bool shared=false)

  Construct an image from a raw memory buffer.

- **CImg** (const T *const data_buffer, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1, const bool shared=false)
- template<typename t>
  CImg< T > & **assign** (const t *const data_buffer, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  In-place version of the previous constructor.

- **CImg**< T > & **assign** (const T *const data_buffer, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)
- template<typename t>
  CImg< T > & **assign** (const t *const data_buffer, const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const bool shared)

  In-place version of the previous constructor, allowing to force the shared state of the instance image.

- **CImg**< T > & **assign** (const T *const data_buffer, const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const bool shared)
- template<typename t>
  CImg (const **CImg**< t > &img)

  Default copy constructor.

- **CImg** (const **CImg**< T > &img)
- template<typename t>
  CImg< T > & **assign** (const **CImg**< t > &img)

  In-place version of the default copy constructor.

- template<typename t>
  CImg (const **CImg**< t > &img, const bool shared)

  Advanced copy constructor.

- **CImg** (const **CImg**< T > &img, const bool shared)
- template<typename t>
  CImg< T > & **assign** (const **CImg**< t > &img, const bool shared)

  In-place version of the advanced constructor.

- **CImg** (const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const int val0, const int val1,...)

  Construct an image with given size (`dx,dy,dz,dv`*) and with specified pixel values (int version).*

- **CImg**< T > & **assign** (const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const int val0, const int val1,...)

  In-place version of the previous constructor.

- **CImg** (const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const double val0, const double val1,...)

  Construct an image with given size (`dx,dy,dz,dv`*) and with specified pixel values (double version).*

- **CImg**< T > & **assign** (const unsigned int dx, const unsigned int dy, const unsigned int dz, const unsigned int dv, const double val0, const double val1,...)

  In-place version of the previous constructor.

- template<typename t>
  CImg (const **CImg**< t > &img, const char *const dimensions)

  Construct an image using dimensions of another image.

- template<typename t>
  CImg< T > & **assign** (const **CImg**< t > &img, const char *const dimensions)

  In-place version of the previous constructor.

- template<typename t>
  CImg (const **CImg**< t > &img, const char *const dimensions, const T val)

  Construct an image using dimensions of another image, and fill it with a default value.

- template<typename t>
  CImg< T > & **assign** (const **CImg**< t > &img, const char *const dimensions, const T val)

  In-place version of the previous constructor.

- **CImg** (const char *const filename)

  Construct an image from an image file.

- **CImg**< T > & **assign** (const char *const filename)

  In-place version of the previous constructor.

- **CImg** (const **CImgDisplay** &disp)

  *Construct an image from the content of a **CImgDisplay*** (p. *135) instance.*

- **CImg**< T > & **assign** (const **CImgDisplay** &disp)

  In-place version of the previous constructor.

- **CImg**< T > & **swap** (**CImg**< T > &img)
- **CImg**< T > & **transfer_to** (**CImg**< T > &img)
- template<typename t>
  CImg< t > & **transfer_to** (**CImg**< t > &img)

Image Informations

- unsigned long **size** () const

  Return the total number of pixel values in an image.

- int **dimx** () const

  Return the number of columns of the instance image (size along the X-axis, i.e image width).

- int **dimy** () const

  Return the number of rows of the instance image (size along the Y-axis, i.e image height).

- int **dimz** () const

  Return the number of slices of the instance image (size along the Z-axis).

- int **dimv** () const

  Return the number of vector channels of the instance image (size along the V-axis).

- template<typename t>
  bool **is_sameX** (const **CImg**< t > &img) const

  Return `true` *if images (∗this) and* `img` *have same width.*

- bool **is_sameX** (const **CImgDisplay** &disp) const

  Return `true` *if images (∗this) and the display* `disp` *have same width.*

- template<typename t>
  bool **is_sameY** (const **CImg**< t > &img) const

  Return `true` *if images (∗this) and* `img` *have same height.*

- bool **is_sameY** (const **CImgDisplay** &disp) const

  Return `true` *if images (∗this) and the display* `disp` *have same height.*

- template<typename t>
  bool **is_sameZ** (const **CImg**< t > &img) const

  Return `true` *if images (∗this) and* `img` *have same depth.*

- template<typename t>
  bool **is_sameV** (const **CImg**< t > &img) const

  Return `true` *if images (∗this) and* `img` *have same dim.*

- template<typename t>
  bool **is_sameXY** (const **CImg**< t > &img) const

  Return `true` *if images have same width and same height.*

- bool **is_sameXY** (const **CImgDisplay** &disp) const

  Return `true` *if image (*this) and the display* `disp` *have same width and same height.*

- template<typename t>
  bool **is_sameXZ** (const **CImg**< t > &img) const

  Return `true` *if images have same width and same depth.*

- template<typename t>
  bool **is_sameXV** (const **CImg**< t > &img) const

  Return `true` *if images have same width and same number of channels.*

- template<typename t>
  bool **is_sameYZ** (const **CImg**< t > &img) const

  Return `true` *if images have same height and same depth.*

- template<typename t>
  bool **is_sameYV** (const **CImg**< t > &img) const

  Return `true` *if images have same height and same number of channels.*

- template<typename t>
  bool **is_sameZV** (const **CImg**< t > &img) const

  Return `true` *if images have same depth and same number of channels.*

- template<typename t>
  bool **is_sameXYZ** (const **CImg**< t > &img) const

  Return `true` *if images have same width, same height and same depth.*

- template<typename t>
  bool **is_sameXYV** (const **CImg**< t > &img) const

  Return `true` *if images have same width, same height and same number of channels.*

- template<typename t>
  bool **is_sameXZV** (const **CImg**< t > &img) const

  Return `true` *if images have same width, same depth and same number of channels.*

- template<typename t>
  bool **is_sameYZV** (const **CImg**< t > &img) const

  Return `true` *if images have same heigth, same depth and same number of channels.*

- template<typename t>
  bool **is_sameXYZV** (const **CImg**< t > &img) const

  Return `true` *if images (*this) and* `img` *have same width, same height, same depth and same number of channels.*

- bool **contains** (const int x, const int y=0, const int z=0, const int v=0) const

  Return `true` *if pixel (x,y,z,v) is inside the image boundaries.*

- template<typename t>
  bool **contains** (const T &pixel, t &x, t &y, t &z, t &v) const

  Return `true` *if pixel is inside the image boundaries.*

- template<typename t>
  bool **contains** (const T &pixel, t &x, t &y, t &z) const

  Return `true` *if pixel is inside the image boundaries.*

- template<typename t>
  bool **contains** (const T &pixel, t &x, t &y) const

  Return `true` *if pixel is inside the image boundaries.*

- template<typename t>
  bool **contains** (const T &pixel, t &x) const

  Return `true` *if pixel is inside the image boundaries.*

- template<typename t>
  bool **contains** (const T &pixel) const

  Return `true` *if pixel is inside the image boundaries.*

- template<typename t>
  bool **is_overlapping** (const **CImg**< t > &img) const

  Return `true` *if the memory buffers of the two images overlaps.*

- bool **is_empty** () const

  Return `true` *if current image is empty.*

- **operator bool** () const

  Image to boolean conversion.

- long **offset** (const int x, const int y, const int z, const int v) const

  Return the offset of the pixel coordinates (`x,y,z,v`*) with respect to the data pointer* `data`.

- long **offset** (const int x, const int y, const int z) const
- long **offset** (const int x, const int y) const
- long **offset** (const int x) const
- T * **ptr** (const unsigned int x, const unsigned int y, const unsigned int z, const unsigned int v)

  Return a pointer to the pixel value located at (`x,y,z,v`*).*

- const T * **ptr** (const unsigned int x, const unsigned int y, const unsigned int z, const unsigned int v) const
- T * **ptr** (const unsigned int x, const unsigned int y, const unsigned int z)
- const T * **ptr** (const unsigned int x, const unsigned int y, const unsigned int z) const
- T * **ptr** (const unsigned int x, const unsigned int y)
- const T * **ptr** (const unsigned int x, const unsigned int y) const
- T * **ptr** (const unsigned int x)
- const T * **ptr** (const unsigned int x) const
- T * **ptr** ()
- const T * **ptr** () const

- **iterator begin** ()

  Return an iterator to the first image pixel.

- **const_iterator begin** () const
- **iterator end** ()

  Return an iterator to the last image pixel.

- **const_iterator end** () const
- T & **operator()** (const unsigned int x, const unsigned int y, const unsigned int z, const unsigned int v)

  Fast access to pixel value for reading or writing.

- const T & **operator()** (const unsigned int x, const unsigned int y, const unsigned int z, const unsigned int v) const
- T & **operator()** (const unsigned int x, const unsigned int y, const unsigned int z)
- const T & **operator()** (const unsigned int x, const unsigned int y, const unsigned int z) const
- T & **operator()** (const unsigned int x, const unsigned int y)
- const T & **operator()** (const unsigned int x, const unsigned int y) const
- T & **operator()** (const unsigned int x)
- const T & **operator()** (const unsigned int x) const
- T & **at** (const unsigned int x, const unsigned int y=0, const unsigned int z=0, const unsigned int v=0)

  Return pixel value at a given position. Equivalent to operator().

- const T & **at** (const unsigned int x, const unsigned int y=0, const unsigned int z=0, const unsigned int v=0) const
- T & **operator[ ]** (const unsigned long off)

  Fast access to pixel value for reading or writing, using an offset to the image pixel.

- const T & **operator[ ]** (const unsigned long off) const
- T & **back** ()

  Return a reference to the last image value.

- const T & **back** () const
- T & **front** ()

  Return a reference to the first image value.

- const T & **front** () const
- T **pix1d** (const int x, const int y, const int z, const int v, const T out_val) const

  Read a pixel value with Dirichlet or Neumann boundary conditions.

- const T & **pix1d** (const int x, const int y=0, const int z=0, const int v=0) const
- T **pix2d** (const int x, const int y, const int z, const int v, const T out_val) const

  Read a pixel value with Dirichlet or Neumann boundary conditions for the two first coordinates (`x,y`*).*

- const T & **pix2d** (const int x, const int y, const int z=0, const int v=0) const
- T **pix3d** (const int x, const int y, const int z, const int v, const T out_val) const

  Read a pixel value with Dirichlet or Neumann boundary conditions for the three first coordinates (`x,y,z`*).*

- const T & **pix3d** (const int x, const int y, const int z, const int v=0) const
- T **pix4d** (const int x, const int y, const int z, const int v, const T out_val) const

Read a pixel value with Dirichlet or Neumann boundary conditions.

- T **pix4d** (const int x, const int y, const int z, const int v) const
- cimg::superset< T, float >::type **linear_pix1d** (const float fx, const int y, const int z, const int v, const T out_val) const

  Read a pixel value using linear interpolation for the first coordinate `cx`.

- cimg::superset< T, float >::type **linear_pix1d** (const float fx, const int y=0, const int z=0, const int v=0) const
- cimg::superset< T, float >::type **linear_pix2d** (const float fx, const float fy, const int z, const int v, const T out_val) const

  Read a pixel value using linear interpolation for the two first coordinates (`cx,cy`*).*

- cimg::superset< T, float >::type **linear_pix2d** (const float fx, const float fy, const int z=0, const int v=0) const
- cimg::superset< T, float >::type **linear_pix3d** (const float fx, const float fy, const float fz, const int v, const T out_val) const

  Read a pixel value using linear interpolation for the three first coordinates (`cx,cy,cz`*).*

- cimg::superset< T, float >::type **linear_pix3d** (const float fx, const float fy=0, const float fz=0, const int v=0) const
- cimg::superset< T, float >::type **linear_pix4d** (const float fx, const float fy, const float fz, const float fv, const T out_val) const

  Read a pixel value using linear interpolation.

- cimg::superset< T, float >::type **linear_pix4d** (const float fx, const float fy=0, const float fz=0, const float fv=0) const
- cimg::superset< T, float >::type **cubic_pix1d** (const float fx, const int y, const int z, const int v, const T out_val) const

  Read a pixel value using cubic interpolation for the first coordinate `cx`.

- cimg::superset< T, float >::type **cubic_pix1d** (const float fx, const int y=0, const int z=0, const int v=0) const
- cimg::superset< T, float >::type **cubic_pix2d** (const float fx, const float fy, const int z, const int v, const T out_val) const

  Read a pixel value using bicubic interpolation.

- cimg::superset< T, float >::type **cubic_pix2d** (const float fx, const float fy, const int z=0, const int v=0) const
- const T & **max** () const

  Return a reference to the maximum pixel value of the instance image.

- T & **max** ()

  Return a reference to the maximum pixel value of the instance image.

- const T & **min** () const

  Return a reference to the minimum pixel value of the instance image.

- T & **min** ()

  Return a reference to the minimum pixel value of the instance image.

- template<typename t>
  const T & **minmax** (t &max_val) const

  Return a reference to the minimum pixel value and return also the maximum pixel value.

- template<typename t>
  T & **minmax** (t &max_val)

  Return a reference to the minimum pixel value and return also the maximum pixel value.

- template<typename t>
  const T & **maxmin** (t &min_val) const

  Return a reference to the maximum pixel value and return also the minimum pixel value.

- template<typename t>
  T & **maxmin** (t &min_val)

  Return a reference to the maximum pixel value and return also the minimum pixel value.

- double **mean** () const

  Return the mean pixel value of the instance image.

- template<typename t>
  double **variancemean** (const unsigned int variance_method, t &mean) const

  Return the variance and the mean of the image.

- double **variance** (const unsigned int variance_method=0) const

  Return the variance and the mean of the image.

- template<typename t>
  double **MSE** (const **CImg**< t > &img) const

  Compute the MSE (Mean-Squared Error) between two images.

- template<typename t>
  double **PSNR** (const **CImg**< t > &img, const double valmax=255.0) const

  Compute the PSNR between two images.

- double **trace** () const

  Return the trace of the current matrix.

- T **median** () const

  Return the median of the image.

- template<typename t>
  double **dot** (const **CImg**< t > &img) const

  Return the dot product of the current vector/matrix with the vector/matrix `img`.

- double **det** () const

  Return the determinant of the current matrix.

- double **norm** (const int norm_type=2) const

  Return the norm of the current vector/matrix. `ntype` *= norm type (0=L2, 1=L1, -1=Linf).*

- double **sum** () const

  Return the sum of all the pixel values in an image.

- const T **kth_smallest** (const unsigned int k) const

  Return the kth smallest element of the image.

- const **CImg**< T > & **print** (const char *title=0, const int print_flag=1) const

  Display informations about the image on the standard error output.

- const **CImg**< T > & **print** (const int print_flag) const

  Display informations about the image on the standard output.

- static const char * **pixel_type** ()

  Return the type of the pixel values.

Arithmetic and Boolean Operators

- template<typename t>
  CImg< T > & **operator=** (const **CImg**< t > &img)

  Assignment operator.

- **CImg**< T > & **operator=** (const **CImg**< T > &img)
- **CImg**< T > & **operator=** (const T *buf)

  Assign values of a C-array to the instance image.

- **CImg**< T > & **operator=** (const T val)

  Assign a value to each image pixel of the instance image.

- **CImg**< T > **operator+** () const

  Operator+.

- template<typename t>
  CImg< T > & **operator+=** (const t val)

  Operator+=;.

- template<typename t>
  CImg< T > & **operator+=** (const **CImg**< t > &img)

  Operator+=.

- **CImg**< T > & **operator++** ()

  Operator++ (prefix).

- **CImg**< T > **operator++** (int)

  Operator++ (postfix).

- **CImg**< T > **operator-** () const

  Operator-.

- template<typename t>
  CImg< T > & **operator-=** (const t val)

  Operator-=.

- template<typename t>
  CImg< T > & **operator-=** (const **CImg**< t > &img)

  Operator-=.

- **CImg**< T > & **operator–** ()

  Operator– (prefix).

- **CImg**< T > **operator–** (int)

  Operator– (postfix).

- template<typename t>
  CImg< T > & **operator*=** (const t val)

  Operator=.*

- template<typename t>
  CImg< T > & **operator*=** (const **CImg**< t > &img)

  Operator=.*

- template<typename t>
  CImg< T > & **operator/=** (const t val)

  Operator/=.

- template<typename t>
  CImg< T > & **operator/=** (const **CImg**< t > &img)

  Operator/=.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **operator%** (const **CImg**< t > &img) const

  Modulo.

- **CImg**< T > **operator%** (const T val) const

  Modulo.

- **CImg**< T > & **operator%=** (const T val)

  In-place modulo.

- template<typename t>
  CImg< T > & **operator%=** (const **CImg**< t > &img)

  In-place modulo.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **operator &** (const **CImg**< t > &img) const

  Bitwise AND.

- **CImg**< T > **operator &** (const T val) const

  Bitwise AND.

- template<typename t>
  CImg< T > & **operator &=** (const **CImg**< t > &img)
  In-place bitwise AND.

- **CImg**< T > & **operator &=** (const T val)
  In-place bitwise AND.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **operator|** (const **CImg**< t > &img) const
  Bitwise OR.

- **CImg**< T > **operator|** (const T val) const
  Bitwise OR.

- template<typename t>
  CImg< T > & **operator|=** (const **CImg**< t > &img)
  In-place bitwise OR.

- **CImg**< T > & **operator|=** (const T val)
  In-place bitwise OR.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **operator^** (const **CImg**< t > &img) const
  Bitwise XOR.

- **CImg**< T > **operator^** (const T val) const
  Bitwise XOR.

- template<typename t>
  CImg< T > & **operator^=** (const **CImg**< t > &img)
  In-place bitwise XOR.

- **CImg**< T > & **operator^=** (const T val)
  In-place bitwise XOR.

- **CImg**< T > **operator~** () const
  Bitwise NOT.

- **CImg**< T > & **operator<<=** (const int n)
  Bitwise shift.

- **CImg**< T > **operator<<** (const int n) const
  Bitwise shift.

- **CImg**< T > & **operator>>=** (const int n)
  Bitwise shift.

- **CImg**< T > **operator>>** (const int n) const
  Bitwise shift.

- template<typename t>
  bool **operator==** (const **CImg**< t > &img) const

  Boolean equality.

- template<typename t>
  bool **operator!=** (const **CImg**< t > &img) const

  Boolean difference.

- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **operator**<< (const **CImg**< t > &img) const

  Return a list of two images { ∗this, img }.

- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **operator**<< (const **CImgList**< t > &list) const

  Return a copy of `list`*, where image ∗this has been inserted at first position.*

- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **operator**>> (const **CImg**< t > &img) const

  Return a list of two images { ∗this, img }.

- template<typename t>
  CImgList< t > & **operator**>> (const **CImgList**< t > &list) const

  Insert an image into the begining of an image list.

- const **CImg**< T > & **operator**>> (**CImgDisplay** &disp) const

  *Display an image into a **CImgDisplay*** (p. *135)**.*

Usual Mathematics Functions

- template<typename t>
  CImg< T > **get_apply** (t &func) const

  Apply a R->R function on all pixel values.

- template<typename t>
  CImg< T > & **apply** (t &func)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_mul** (const **CImg**< t > &img) const

  Pointwise multiplication between two images.

- template<typename t>
  CImg< T > & **mul** (const **CImg**< t > &img)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_div** (const **CImg**< t > &img) const

  Pointwise division between two images.

- template<typename t>
  CImg< T > & **div** (const **CImg**< t > &img)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_max** (const **CImg**< t > &img) const

  Pointwise max operator between two images.

- template<typename t>
  CImg< T > & **max** (const **CImg**< t > &img)

  In-place version of the previous function.

- **CImg**< T > **get_max** (const T val) const

  Pointwise max operator between an image and a value.

- **CImg**< T > & **max** (const T val)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_min** (const **CImg**< t > &img) const

  Pointwise min operator between two images.

- template<typename t>
  CImg< T > & **min** (const **CImg**< t > &img)

  In-place version of the previous function.

- **CImg**< T > **get_min** (const T val) const

  Pointwise min operator between an image and a value.

- **CImg**< T > & **min** (const T val)

  In-place version of the previous function.

- **CImg**< typename cimg::last< T, double >::type > **get_stats** () const

  Compute a statistics vector (min,max,mean,variance,offmin,offmax).

- **CImg**< T > & **stats** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_sqr** () const

  Compute the square of each pixel value.

- **CImg**< T > & **sqr** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_sqrt** () const

  Compute the square root of each pixel value.

- **CImg**< T > & **sqrt** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_exp** () const
  Compute the exponential of each pixel value.
- **CImg**< T > & **exp** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_log** () const
  Compute the log of each each pixel value.
- **CImg**< T > & **log** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_log10** () const
  Compute the log10 of each each pixel value.
- **CImg**< T > & **log10** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_pow** (const double p) const
  Compute the power by p of each pixel value.
- **CImg**< T > & **pow** (const double p)
  In-place version of the previous function.
- template<typename t>
  CImg< typename cimg::superset< T, float >::type > **get_pow** (const **CImg**< t > &img) const
  Compute the power of each pixel value.
- template<typename t>
  CImg< T > & **pow** (const **CImg**< t > &img)
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_abs** () const
  Compute the absolute value of each pixel value.
- **CImg**< T > & **abs** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_cos** () const
  Compute the cosinus of each pixel value.
- **CImg**< T > & **cos** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_sin** () const
  Compute the sinus of each pixel value.

- **CImg**< T > & **sin** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_tan** () const
  Compute the tangent of each pixel.
- **CImg**< T > & **tan** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_acos** () const
  Compute the arc-cosine of each pixel value.
- **CImg**< T > & **acos** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_asin** () const
  Compute the arc-sinus of each pixel value.
- **CImg**< T > & **asin** ()
  In-place version of the previous function.
- **CImg**< typename cimg::superset< T, float >::type > **get_atan** () const
  Compute the arc-tangent of each pixel.
- **CImg**< T > & **atan** ()
  In-place version of the previous function.
- **CImg**< T > **get_round** (const float x, const unsigned int round_type=0) const
  Compute image with rounded pixel values.
- **CImg**< T > & **round** (const float x, const unsigned int round_type=0)
  In-place version of the previous function.
- **CImg**< T > **get_rand** (const T val_min, const T val_max) const
  Fill image with random values between specified range.
- **CImg**< T > & **rand** (const T val_min, const T val_max)
  In-place version of the previous function.

Usual Image Transformations

- **CImg**< T > **get_fill** (const T val) const
  Fill an image by a value `val`.
- **CImg**< T > & **fill** (const T val)
  In-place version of the previous function.
- **CImg**< T > **get_fill** (const T val0, const T val1) const

Fill sequentially all pixel values with values val0 *and* val1 *respectively.*

- **CImg**< T > & **fill** (const T val0, const T val1)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2) const

  Fill sequentially all pixel values with values val0 *and* val1 *and* val2*.*

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3) const

  Fill sequentially all pixel values with values val0 *and* val1 *and* val2 *and* val3*.*

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4) const

  Fill sequentially all pixel values with values val0 *and* val1 *and* val2 *and* val3 *and* val4*.*

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5) const

  Fill sequentially all pixel values with values val0 *and* val1 *and* val2 *and* val3 *and* val4 *and* val5*.*

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12, const T val13) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12, const T val13)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12, const T val13, const T val14) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12, const T val13, const T val14)

  In-place version of the previous function.

- **CImg**< T > **get_fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12, const T val13, const T val14, const T val15) const

  Fill sequentially pixel values.

- **CImg**< T > & **fill** (const T val0, const T val1, const T val2, const T val3, const T val4, const T val5, const T val6, const T val7, const T val8, const T val9, const T val10, const T val11, const T val12, const T val13, const T val14, const T val15)

  In-place version of the previous function.

- template<int N>
  CImg< T > **get_fill** (const int val0,...) const

  Fill sequentially pixel values.

- template<int N>
  CImg< T > & **fill** (const int val0,...)

  In-place version of the previous function.

- template<int N>
  CImg< T > **get_fill** (const double val0,...) const

  Fill sequentially pixel values.

- template<int N>
  CImg< T > & **fill** (const double val0,...)

  In-place version of the previous function.

- template<int N, typename t>
  CImg< T > & **_fill** (const t val0, va_list &ap)
- **CImg**< T > & **fillV** (const unsigned int x, const unsigned int y, const unsigned int z, const int a0,...)

  Fill image values along the V-axis at the specified pixel position (x,y,z) (int version).

- **CImg**< T > & **fillV** (const unsigned int x, const unsigned int y, const unsigned int z, const double a0,...)

  Fill image values along the V-axis at the specified pixel position (x,y,z) (double version).

- **CImg**< T > & **fillZV** (const unsigned int x, const unsigned int y, const int a0,...)

  Fill image values along the ZV-axes at the specified pixel position (x,y) (int version).

- **CImg**< T > & **fillZV** (const unsigned int x, const unsigned int y, const double a0,...)

  Fill image values along the ZV-axes at the specified pixel position (x,y) (double version).

- **CImg**< T > & **fillYZV** (const unsigned int x, const int a0,...)

  Fill image values along the YZV-axes at the specified pixel position x (int version).

- **CImg**< T > & **fillYZV** (const unsigned int x, const double a0,...)

Fill image values along the YZV-axes at the specified pixel position x (double version).

- **CImg**< T > **get_normalize** (const T a, const T b) const

  Linear normalization of the pixel values between a *and* b.

- **CImg**< T > & **normalize** (const T a, const T b)

  In-place version of the previous function.

- **CImg**< T > **get_cut** (const T a, const T b) const

  Cut pixel values between a *and* b.

- **CImg**< T > & **cut** (const T a, const T b)

  In-place version of the previous function.

- **CImg**< T > **get_quantize** (const unsigned int n=256, const bool keep_range=true) const

  Quantize pixel values into
  levels.

- **CImg**< T > & **quantize** (const unsigned int n=256, const bool keep_range=true)

  In-place version of the previous function.

- **CImg**< T > **get_threshold** (const T thres) const

  Threshold the image.

- **CImg**< T > & **threshold** (const T thres)

  In-place version of the previous function.

- **CImg**< T > **get_rotate** (const float angle, const unsigned int cond=3) const

  Return a rotated image.

- **CImg**< T > & **rotate** (const float angle, const unsigned int cond=3)

  In-place version of the previous function.

- **CImg**< T > **get_rotate** (const float angle, const float cx, const float cy, const float zoom=1, const unsigned int cond=3) const

  Return a rotated image around the point (`cx,cy`*).*

- **CImg**< T > & **rotate** (const float angle, const float cx, const float cy, const float zoom=1, const unsigned int cond=3)

  In-place version of the previous function.

- **CImg**< T > **get_resize** (const int pdx=-100, const int pdy=-100, const int pdz=-100, const int pdv=-100, const int interp=1, const int border_condition=-1, const bool center=false) const

  Return a resized image.

- **CImg**< T > & **resize** (const int pdx=-100, const int pdy=-100, const int pdz=-100, const int pdv=-100, const int interp=1, const int border_condition=-1, const bool center=false)

  In-place version of the previous function.

- template<typename t>
  CImg< T > **get_resize** (const **CImg**< t > &src, const int interp=1, const int border_condition=-1, const bool center=false) const

  Return a resized image.

- template<typename t>
  CImg< T > & **resize** (const **CImg**< t > &src, const int interp=1, const int border_condition=-1, const bool center=false)

  In-place version of the previous function.

- **CImg**< T > **get_resize** (const **CImgDisplay** &disp, const int interp=1, const int border_condition=-1, const bool center=false) const

  Return a resized image.

- **CImg**< T > & **resize** (const **CImgDisplay** &disp, const int interp=1, const int border_condition=-1, const bool center=false)

  In-place version of the previous function.

- **CImg**< T > **get_permute_axes** (const char *permut="vxyz") const

  Permute axes order.

- **CImg**< T > & **permute_axes** (const char *order="vxyz")

  In-place version of the previous function.

- **CImg**< T > **get_resize_halfXY** () const

  Return an half-resized image, using a special filter.

- **CImg**< T > & **resize_halfXY** ()

  In-place version of the previous function.

- **CImg**< T > **get_mirror** (const char axe='x') const

  Mirror an image along the specified axis.

- **CImg**< T > & **mirror** (const char axe='x')

  In-place version of the previous function.

- **CImg**< T > **get_translate** (const int deltax, const int deltay=0, const int deltaz=0, const int deltav=0, const int border_condition=0) const

  Translate the image.

- **CImg**< T > & **translate** (const int deltax, const int deltay=0, const int deltaz=0, const int deltav=0, const int border_condition=0)

  In-place version of the previous function.

- **CImg**< T > **get_crop** (const int x0, const int y0, const int z0, const int v0, const int x1, const int y1, const int z1, const int v1, const bool border_condition=false) const

  Return a square region of the image, as a new image.

- **CImg**< T > & **crop** (const int x0, const int y0, const int z0, const int v0, const int x1, const int y1, const int z1, const int v1, const bool border_condition=false)

  In-place version of the previous function.

- **CImg**< T > **get_crop** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const bool border_condition=false) const

  Return a square region of the image, as a new image.

- **CImg**< T > & **crop** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const bool border_condition=false)

  In-place version of the previous function.

- **CImg**< T > **get_crop** (const int x0, const int y0, const int x1, const int y1, const bool border_condition=false) const

  Return a square region of the image, as a new image.

- **CImg**< T > & **crop** (const int x0, const int y0, const int x1, const int y1, const bool border_condition=false)

  In-place version of the previous function.

- **CImg**< T > **get_crop** (const int x0, const int x1, const bool border_condition=false) const

  Return a square region of the image, as a new image.

- **CImg**< T > & **crop** (const int x0, const int x1, const bool border_condition=false)

  In-place version of the previous function.

- **CImg**< T > **get_columns** (const unsigned int x0, const unsigned int x1) const

  Return a set of columns.

- **CImg**< T > & **columns** (const unsigned int x0, const unsigned int x1)

  In-place version of the previous function.

- **CImg**< T > **get_column** (const unsigned int x0) const

  Return one column.

- **CImg**< T > & **column** (const unsigned int x0)

  In-place version of the previous function.

- **CImg**< T > **get_lines** (const unsigned int y0, const unsigned int y1) const

  Get a copy of a set of lines of the instance image.

- **CImg**< T > & **lines** (const unsigned int y0, const unsigned int y1)

  In-place version of the previous function.

- **CImg**< T > **get_line** (const unsigned int y0) const

  Get a copy of a line of the instance image.

- **CImg**< T > & **line** (const unsigned int y0)

  In-place version of the previous function.

- **CImg**< T > **get_slices** (const unsigned int z0, const unsigned int z1) const

  Get a set of slices.

- **CImg**< T > & **slices** (const unsigned int z0, const unsigned int z1)

  In-place version of the previous function.

- **CImg**< T > **get_slice** (const unsigned int z0) const

  Get the z-slice z *of* ∗*this, as a new image.*

- **CImg**< T > & **slice** (const unsigned int z0)

  In-place version of the previous function.

- **CImg**< T > **get_channels** (const unsigned int v0, const unsigned int v1) const

  Return a copy of a set of channels of the instance image.

- **CImg**< T > & **channels** (const unsigned int v0, const unsigned int v1)

  In-place version of the previous function.

- **CImg**< T > **get_channel** (const unsigned int v0) const

  Return a copy of a channel of the instance image.

- **CImg**< T > & **channel** (const unsigned int v0)

  In-place version of the previous function.

- **CImg**< T > **get_shared_points** (const unsigned int x0, const unsigned int x1, const unsigned int y0=0, const unsigned int z0=0, const unsigned int v0=0)

  Get a shared-memory image referencing a set of points of the instance image.

- const **CImg**< T > **get_shared_points** (const unsigned int x0, const unsigned int x1, const unsigned int y0=0, const unsigned int z0=0, const unsigned int v0=0) const

  Get a shared-memory image referencing a set of points of the instance image (const version).

- **CImg**< T > **get_shared_lines** (const unsigned int y0, const unsigned int y1, const unsigned int z0=0, const unsigned int v0=0)

  Return a shared-memory image referencing a set of lines of the instance image.

- const **CImg**< T > **get_shared_lines** (const unsigned int y0, const unsigned int y1, const unsigned int z0=0, const unsigned int v0=0) const

  Return a shared-memory image referencing a set of lines of the instance image (const version).

- **CImg**< T > **get_shared_line** (const unsigned int y0, const unsigned int z0=0, const unsigned int v0=0)

  Return a shared-memory image referencing one particular line (y0,z0,v0) of the instance image.

- const **CImg**< T > **get_shared_line** (const unsigned int y0, const unsigned int z0=0, const unsigned int v0=0) const

  Return a shared-memory image referencing one particular line (y0,z0,v0) of the instance image (const version).

- **CImg**< T > **get_shared_planes** (const unsigned int z0, const unsigned int z1, const unsigned int v0=0)

  Return a shared memory image referencing a set of planes (z0->z1,v0) of the instance image.

- const **CImg**< T > **get_shared_planes** (const unsigned int z0, const unsigned int z1, const unsigned int v0=0) const

  Return a shared-memory image referencing a set of planes (z0->z1,v0) of the instance image (const version).

- **CImg**< T > **get_shared_plane** (const unsigned int z0, const unsigned int v0=0)

  Return a shared-memory image referencing one plane (z0,v0) of the instance image.

- const **CImg**< T > **get_shared_plane** (const unsigned int z0, const unsigned int v0=0) const

  Return a shared-memory image referencing one plane (z0,v0) of the instance image (const version).

- **CImg**< T > **get_shared_channels** (const unsigned int v0, const unsigned int v1)

  Return a shared-memory image referencing a set of channels (v0->v1) of the instance image.

- const **CImg**< T > **get_shared_channels** (const unsigned int v0, const unsigned int v1) const

  Return a shared-memory image referencing a set of channels (v0->v1) of the instance image (const version).

- **CImg**< T > **get_shared_channel** (const unsigned int v0)

  Return a shared-memory image referencing one channel v0 of the instance image.

- const **CImg**< T > **get_shared_channel** (const unsigned int v0) const

  Return a shared-memory image referencing one channel v0 of the instance image (const version).

- **CImg**< T > **get_shared** ()

  Return a shared version of the instance image.

- const **CImg**< T > **get_shared** () const

  Return a shared version of the instance image (const version).

- **CImg**< T > **get_projections2d** (const unsigned int x0, const unsigned int y0, const unsigned int z0, const int dx=-100, const int dy=-100, const int dz=-100) const

  Return a 2D representation of a 3D image, with three slices.

- **CImg**< T > & **projections2d** (const unsigned int x0, const unsigned int y0, const unsigned int z0, const int dx=-100, const int dy=-100, const int dz=-100)

  In-place version of the previous function.

- **CImg**< typename cimg::last< T, float >::type > **get_histogram** (const unsigned int nblevels=256, const T val_min=(T) 0, const T val_max=(T) 0) const

  Return the image histogram.

- **CImg**< T > & **histogram** (const unsigned int nblevels=256, const T val_min=(T) 0, const T val_max=(T) 0)

  In-place version of the previous function.

- **CImg**< T > **get_equalize_histogram** (const unsigned int nblevels=256, const T val_min=(T) 0, const T val_max=(T) 0) const

  Return the histogram-equalized version of the current image.

- **CImg**< T > & **equalize_histogram** (const unsigned int nblevels=256, const T val_min=(T) 0, const T val_max=(T) 0)

In-place version of the previous function.

- **CImg**< typename cimg::last< T, unsigned int >::type > **get_label_regions** () const

  Get a label map of disconnected regions with same intensities.

- **CImg**< T > & **label_regions** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_norm_pointwise** (int norm_type=2) const

  Return the scalar image of vector norms.

- **CImg**< T > & **norm_pointwise** (int norm_type=2)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_orientation_pointwise** () const

  Return the image of normalized vectors.

- **CImg**< T > & **orientation_pointwise** ()

  In-place version of the previous function.

- **CImgList**< T > **get_split** (const char axe='x', const unsigned int nb=0) const

  Split image into a list.

- **CImg**< T > **get_append** (const **CImg**< T > &img, const char axis='x', const char align='c') const

  Append an image to another one.

- **CImg**< T > & **append** (const **CImg**< T > &img, const char axis='x', const char align='c')

  In-place version of the previous function.

- **CImgList**< typename cimg::superset< T, float >::type > **get_gradientXY** (const int scheme=0) const

  Return a list of images, corresponding to the XY-gradients of an image.

- **CImgList**< typename cimg::superset< T, float >::type > **get_gradientXYZ** (const int scheme=0) const

  Return a list of images, corresponding to the XYZ-gradients of an image.

- **CImg**< typename cimg::superset< T, float >::type > **get_structure_tensorXY** (const int scheme=1) const

  Return the 2D structure tensor field of an image.

- **CImg**< T > & **structure_tensorXY** (const int scheme=1)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_structure_tensorXYZ** (const int scheme=1) const

  Return the 3D structure tensor field of an image.

- **CImg**< T > & **structure_tensorXYZ** (const int scheme=1)

  In-place version of the previous function.

- **CImgList**< typename cimg::superset< T, float >::type > **get_hessianXY** ()

  Get components of the 2D Hessian matrix of an image.

- **CImgList**< typename cimg::superset< T, float >::type > **get_hessianXYZ** ()

  Get components of the 3D Hessian matrix of an image.

- **CImg**< typename cimg::superset< T, float >::type > **get_distance_function** (const unsigned int nb_iter=100, const float band_size=0.0f, const float precision=0.5f) const

  Get distance function from 0-valued isophotes by the application of the eikonal equation.

- **CImg**< T > & **distance_function** (const unsigned int nb_iter=100, const float band_size=0.0f, const float precision=0.5f)

  In-place version of the previous function.

- template<typename t>
  CImg< T > **get_dijkstra** (const unsigned int starting_node, const unsigned int ending_node, **CImg**< t > &previous) const

  Return minimal path in a graph, using the Dijkstra algorithm.

- template<typename t>
  CImg< T > & **dijkstra** (const unsigned int starting_node, const unsigned int ending_node, **CImg**< t > &previous)
- **CImg**< typename cimg::superset< T, float >::type > **get_dijkstra** (const unsigned int starting_node, const unsigned int ending_node=~0U) const

  Return minimal path in a graph, using the Dijkstra algorithm.

- **CImg**< T > & **dijkstra** (const unsigned int starting_node, const unsigned int ending_node=~0U)
- template<typename tf, typename t>
  static **CImg**< T > **get_dijkstra** (const tf &distance, const unsigned int nb_nodes, const unsigned int starting_node, const unsigned int ending_node, **CImg**< t > &previous)

  Return minimal path in a graph, using the Dijkstra algorithm.

- template<typename tf, typename t>
  static **CImg**< T > **get_dijkstra** (const tf &distance, const unsigned int nb_nodes, const unsigned int starting_node, const unsigned int ending_node=~0U)

Meshes and Triangulations

- template<typename tp, typename tf>
  const **CImg**< T > & **marching_squares** (const float isovalue, **CImgList**< tp > &points, **CImgList**< tf > &primitives) const

  Get a vectorization of an implicit function defined by the instance image.

- template<typename tp, typename tf>
  const **CImg**< T > & **marching_squares** (const float isovalue, const float resx, const float resy, **CImgList**< tp > &points, **CImgList**< tf > &primitives) const

  Get a vectorization of an implicit function defined by the instance image.

- template<typename tp, typename tf>
  const **CImg**< T > & **marching_cubes** (const float isovalue, **CImgList**< tp > &points, **CImgList**< tf > &primitives, const bool invert_faces=false) const

  Get a triangulation of an implicit function defined by the instance image.

- template<typename tp, typename tf>
  const **CImg**< T > & **marching_cubes** (const float isovalue, const float resx, const float resy, const float resz, **CImgList**< tp > &points, **CImgList**< tf > &primitives, const bool invert_faces=false) const

  Get a triangulation of an implicit function defined by the instance image.

Color conversions

- template<typename t>
  CImg< t > **get_RGBtoLUT** (const **CImg**< t > &palette, const bool dithering=true, const bool indexing=false) const

  Convert color pixels from (R,G,B) to match a specified palette.

- **CImg**< T > & **RGBtoLUT** (const **CImg**< T > &palette, const bool dithering=true, const bool indexing=false)

  In-place version of the previous function.

- **CImg**< T > **get_RGBtoLUT** (const bool dithering=true, const bool indexing=false) const

  Convert color pixels from (R,G,B) to match the default 256 colors palette.

- **CImg**< T > & **RGBtoLUT** (const bool dithering=true, const bool indexing=false)

  In-place version of the previous function.

- template<typename t>
  CImg< t > **get_LUTtoRGB** (const **CImg**< t > &palette) const

  Convert an indexed image to a (R,G,B) image using the specified color palette.

- **CImg**< T > & **LUTtoRGB** (const **CImg**< T > &palette)

  In-place version of the previous function.

- **CImg**< T > **get_LUTtoRGB** () const

  Convert an indexed image (with the default palette) to a (R,G,B) image.

- **CImg**< T > & **LUTtoRGB** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_RGBtoHSV** () const

  Convert color pixels from (R,G,B) to (H,S,V).

- **CImg**< T > & **RGBtoHSV** ()

  In-place version of the previous function.

- **CImg**< T > **get_HSVtoRGB** () const

  Convert color pixels from (H,S,V) to (R,G,B).

- **CImg**< T > & **HSVtoRGB** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_RGBtoHSL** () const

  Convert color pixels from (R,G,B) to (H,S,L).

- **CImg**< T > & **RGBtoHSL** ()

  In-place version of the previous function.

- **CImg**< T > **get_HSLtoRGB** () const

  Convert color pixels from (H,S,L) to (R,G,B).

- **CImg**< T > & **HSLtoRGB** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_RGBtoHSI** () const

  Convert color pixels from (R,G,B) to (H,S,I). Reference: "Digital Image Processing, 2nd. edition", R. Gonzalez and R. Woods. Prentice Hall, 2002.

- **CImg**< T > & **RGBtoHSI** ()

  In-place version of the previous function.

- **CImg**< T > **get_HSItoRGB** () const

  Convert color pixels from (H,S,I) to (R,G,B). Reference: "Digital Image Processing, 2nd. edition", R. Gonzalez and R. Woods. Prentice Hall, 2002.

- **CImg**< T > & **HSItoRGB** ()

  In-place version of the previous function.

- **CImg**< T > **get_RGBtoYCbCr** () const

  Convert color pixels from (R,G,B) to (Y,Cb,Cr)_8 (Thanks to Chen Wang).

- **CImg**< T > & **RGBtoYCbCr** ()

  In-place version of the previous function.

- **CImg**< T > **get_YCbCrtoRGB** () const

  Convert color pixels from (Y,Cb,Cr)_8 to (R,G,B).

- **CImg**< T > & **YCbCrtoRGB** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_RGBtoYUV** () const

  Convert color pixels from (R,G,B) to (Y,U,V).

- **CImg**< T > & **RGBtoYUV** ()

  In-place version of the previous function.

- **CImg**< T > **get_YUVtoRGB** () const

  Convert color pixels from (Y,U,V) to (R,G,B).

- **CImg**< T > & **YUVtoRGB** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_RGBtoXYZ** () const

  Convert color pixels from (R,G,B) to (X,Y,Z)_709.

- **CImg**< T > & **RGBtoXYZ** ()

  In-place version of the previous function.

- **CImg**< T > **get_XYZtoRGB** () const

  Convert (X,Y,Z)_709 pixels of a color image into the (R,G,B) color space.

- **CImg**< T > & **XYZtoRGB** ()

  In-place version of the previous function.

- **CImg**< T > **get_XYZtoLab** () const

  Convert (X,Y,Z)_709 pixels of a color image into the (L∗,a∗,b∗) color space.

- **CImg**< T > & **XYZtoLab** ()

  In-place version of the previous function.

- **CImg**< T > **get_LabtoXYZ** () const

  Convert (L,a,b) pixels of a color image into the (X,Y,Z) color space.

- **CImg**< T > & **LabtoXYZ** ()

  In-place version of the previous function.

- **CImg**< T > **get_XYZtoxyY** () const

  Convert (X,Y,Z)_709 pixels of a color image into the (x,y,Y) color space.

- **CImg**< T > & **XYZtoxyY** ()

  In-place version of the previous function.

- **CImg**< T > **get_xyYtoXYZ** () const

  Convert (x,y,Y) pixels of a color image into the (X,Y,Z)_709 color space.

- **CImg**< T > & **xyYtoXYZ** ()

  In-place version of the previous function.

- **CImg**< T > **get_RGBtoLab** () const

  Convert a (R,G,B) image to a (L,a,b) one.

- **CImg**< T > & **RGBtoLab** ()

  In-place version of the previous function.

- **CImg**< T > **get_LabtoRGB** () const

  Convert a (L,a,b) image to a (R,G,B) one.

- **CImg**< T > & **LabtoRGB** ()

In-place version of the previous function.

- **CImg**< T > **get_RGBtoxyY** () const
  Convert a (R,G,B) image to a (x,y,Y) one.
- **CImg**< T > & **RGBtoxyY** ()
  In-place version of the previous function.
- **CImg**< T > **get_xyYtoRGB** () const
  Convert a (x,y,Y) image to a (R,G,B) one.
- **CImg**< T > & **xyYtoRGB** ()
  In-place version of the previous function.
- **CImg**< T > **get_RGBtoBayer** () const
  Convert a (R,G,B) image to a Bayer-coded representation.
- **CImg**< T > & **RGBtoBayer** ()
- **CImg**< T > **get_BayertoRGB** (const unsigned int interpolation_type=3) const
  Convert a Bayer-coded image to a (R,G,B) color image.
- **CImg**< T > & **BayertoRGB** (const unsigned int interpolation_type=3)
- static **CImg**< T > **get_default_LUT8** ()
  Return the default 256 colors palette.
- static **CImg**< T > **get_rainbow_LUT8** ()
  Return a rainbow-palette.
- static **CImg**< T > **get_cluster_LUT8** ()
  Return contrasted palette optmized for cluster visualization.

Drawing

- template<typename tc>
  CImg< T > & **_draw_scanline** (const int x0, const int x1, const int y, const tc ∗const color, const float opacity=1.0f, const float brightness=1.0f, const bool init=false)
- template<typename tc>
  CImg< T > & **_draw_scanline** (const tc ∗const color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_point** (const int x0, const int y0, const tc ∗const color, const float opacity=1.0f)
  Draw a colored point (pixel) in the instance image.
- template<typename tc>
  CImg< T > & **draw_point** (const int x0, const int y0, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_point** (const int x0, const int y0, const int z0, const tc ∗const color, const float opacity=1.0f)

Draw a colored point (pixel) in the instance image (for volumetric images).

- template<typename tc>
  CImg< T > & **draw_point** (const int x0, const int y0, const int z0, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **_draw_point** (const t &points, const tc *const color, const float opacity, const unsigned int W, const unsigned int H)
- template<typename t, typename tc>
  CImg< T > & **draw_point** (const **CImgList**< t > &points, const tc *const color, const float opacity=1.0f)

  Draw a cloud of colored points in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_point** (const **CImgList**< t > &points, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **draw_point** (const **CImg**< t > &points, const tc *const color, const float opacity=1.0f)

  Draw a cloud of points in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_point** (const **CImg**< t > &points, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_line** (const int x0, const int y0, const int x1, const int y1, const tc *const color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a colored line in the instance image.

- template<typename tc>
  CImg< T > & **draw_line** (const int x0, const int y0, const int x1, const int y1, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename tc>
  CImg< T > & **draw_line** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const tc *const color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a colored line in the instance image (for volumetric images).

- template<typename tc>
  CImg< T > & **draw_line** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename t>
  CImg< T > & **draw_line** (const int x0, const int y0, const int x1, const int y1, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a textured line in the instance image.

- template<typename t>
  CImg< T > & **draw_line** (const int x0, const int y0, const float z0, const int x1, const int y1, const float z1, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

Draw a textured line in the instance image, with perspective correction.

- template<typename t, typename tc>
  CImg< T > & **_draw_line** (const t &points, const tc *const color, const float opacity, const unsigned int pattern, const bool init_hatch, const unsigned int W, const unsigned int H)
- template<typename t, typename tc>
  CImg< T > & **draw_line** (const **CImgList**< t > &points, const tc *const color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a set of consecutive colored lines in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_line** (const **CImgList**< t > &points, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename t, typename tc>
  CImg< T > & **draw_line** (const **CImg**< t > &points, const tc *const color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a set of consecutive colored lines in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_line** (const **CImg**< t > &points, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename t, typename tc>
  CImg< T > & **_draw_polygon** (const t &points, const tc *const color, const float opacity, const unsigned int N)
- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImgList**< t > &points, const tc *const color, const float opacity=1.0f)

  Draw a filled polygon in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImgList**< t > &points, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImg**< t > &points, const tc *const color, const float opacity=1.0f)

  Draw a filled polygon in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImg**< t > &points, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **_draw_polygon** (const t &points, const tc *const color, const float opacity, const unsigned int pattern, const unsigned int W, const unsigned int H)
- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImgList**< t > &points, const tc *const color, const float opacity, const unsigned int pattern)
- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImgList**< t > &points, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImg**< t > &points, const tc *const color, const float opacity, const unsigned int pattern)

- template<typename t, typename tc>
  CImg< T > & **draw_polygon** (const **CImg**< t > &points, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **draw_spline** (const int x0, const int y0, const float u0, const float v0, const int x1, const int y1, const float u1, const float v1, const tc *const color, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a cubic spline curve in the instance image.

- template<typename tc>
  CImg< T > & **draw_spline** (const int x0, const int y0, const float u0, const float v0, const int x1, const int y1, const float u1, const float v1, const **CImg**< tc > &color, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename tc>
  CImg< T > & **draw_spline** (const int x0, const int y0, const int z0, const float u0, const float v0, const float w0, const int x1, const int y1, const int z1, const float u1, const float v1, const float w1, const tc *const color, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a cubic spline curve in the instance image (for volumetric images).

- template<typename tc>
  CImg< T > & **draw_spline** (const int x0, const int y0, const int z0, const float u0, const float v0, const float w0, const int x1, const int y1, const int z1, const float u1, const float v1, const float w1, const **CImg**< tc > &color, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename t>
  CImg< T > & **draw_spline** (const int x0, const int y0, const float u0, const float v0, const int x1, const int y1, const float u1, const float v1, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a cubic spline curve in the instance image.

- template<typename tp, typename tt, typename tc>
  CImg< T > & **_draw_spline** (const tp &points, const tt &tangents, const tc *const color, const bool close_set, const float precision, const float opacity, const unsigned int pattern, const bool init_hatch, const unsigned int W, const unsigned int H)
- template<typename tp, typename tc>
  CImg< T > & **_draw_spline** (const tp &points, const tc *const color, const bool close_set, const float precision, const float opacity, const unsigned int pattern, const bool init_hatch, const unsigned int W, const unsigned int H)
- template<typename tp, typename tt, typename tc>
  CImg< T > & **draw_spline** (const **CImgList**< tp > &points, const **CImgList**< tt > &tangents, const tc *const color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)

  Draw a set of consecutive colored splines in the instance image.

- template<typename tp, typename tt, typename tc>
  CImg< T > & **draw_spline** (const **CImgList**< tp > &points, const **CImgList**< tt > &tangents, const **CImg**< tc > &color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=~0U, const bool init_hatch=true)
- template<typename tp, typename tt, typename tc>
  CImg< T > & **draw_spline** (const **CImg**< tp > &points, const **CImg**< tt > &tangents, const tc

∗const color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=∼0U, const bool init_hatch=true)

Draw a set of consecutive colored splines in the instance image.

- template<typename tp, typename tt, typename tc>
  CImg< T > & **draw_spline** (const **CImg**< tp > &points, const **CImg**< tt > &tangents, const **CImg**< tc > &color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=∼0U, const bool init_hatch=true)
- template<typename t, typename tc>
  CImg< T > & **draw_spline** (const **CImgList**< t > &points, const tc ∗const color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=∼0U, const bool init_hatch=true)

  Draw a set of consecutive colored splines in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_spline** (const **CImgList**< t > &points, **CImg**< tc > &color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=∼0U, const bool init_hatch=true)
- template<typename t, typename tc>
  CImg< T > & **draw_spline** (const **CImg**< t > &points, const tc ∗const color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=∼0U, const bool init_hatch=true)

  Draw a set of consecutive colored lines in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_spline** (const **CImg**< t > &points, const **CImg**< tc > &color, const bool close_set=false, const float precision=4.0f, const float opacity=1.0f, const unsigned int pattern=∼0U, const bool init_hatch=true)
- template<typename tc>
  CImg< T > & **draw_arrow** (const int x0, const int y0, const int x1, const int y1, const tc ∗const color, const float angle=30, const float length=-10, const float opacity=1.0f, const unsigned int pattern=∼0U)

  Draw a colored arrow in the instance image.

- template<typename tc>
  CImg< T > & **draw_arrow** (const int x0, const int y0, const int x1, const int y1, const **CImg**< tc > &color, const float angle=30, const float length=-10, const float opacity=1.0f, const unsigned int pattern=∼0U)
- template<typename t>
  CImg< T > & **draw_image** (const **CImg**< t > &sprite, const int x0, const int y0=0, const int z0=0, const int v0=0, const float opacity=1.0f)

  Draw a sprite image in the instance image.

- **CImg**< T > & **draw_image** (const **CImg**< T > &sprite, const int x0, const int y0=0, const int z0=0, const int v0=0, const float opacity=1.0f)
- template<typename ti, typename tm>
  CImg< T > & **draw_image** (const **CImg**< ti > &sprite, const **CImg**< tm > &mask, const int x0, const int y0=0, const int z0=0, const int v0=0, const float mask_valmax=1.0f, const float opacity=1.0f)

  Draw a sprite image in the instance image (masked version).

- **CImg**< T > & **draw_rectangle** (const int x0, const int y0, const int z0, const int v0, const int x1, const int y1, const int z1, const int v1, const T val, const float opacity=1.0f)

  Draw a 4D filled rectangle in the instance image, at coordinates (`x0,y0,z0,v0`*)-(*`x1,y1,z1,v1`*).*

- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const tc *const color, const float opacity=1.0f)

  Draw a 3D filled colored rectangle in the instance image, at coordinates (`x0,y0,z0`*)-(*`x1,y1,z1`*).*

- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const tc *const color, const float opacity, const unsigned int pattern)

  Draw a 3D outlined colored rectangle in the instance image.

- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int z0, const int x1, const int y1, const int z1, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int x1, const int y1, const tc *const color, const float opacity=1.0f)

  Draw a 2D filled colored rectangle in the instance image, at coordinates (`x0,y0`*)-(*`x1,y1`*).*

- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int x1, const int y1, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int x1, const int y1, const tc *const color, const float opacity, const unsigned int pattern)

  Draw a 2D outlined colored rectangle.

- template<typename tc>
  CImg< T > & **draw_rectangle** (const int x0, const int y0, const int x1, const int y1, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **_draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const tc *const color, const float opacity, const float brightness)
- template<typename tc>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const tc *const color, const float opacity=1.0f)

  Draw a 2D filled colored triangle in the instance image.

- template<typename tc>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const tc *const color, const float opacity, const unsigned int pattern)

  Draw a 2D outlined colored triangle.

- template<typename tc>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const tc *const color, const float brightness0, const float brightness1, const float brightness2, const float opacity=1.0f)

  *Draw a 2D Gouraud-filled triangle in the instance image, at coordinates (*x0,y0*)-(*x1,y1*)-(*x2,y2*).*

- template<typename tc>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< tc > &color, const float brightness0, const float brightness1, const float brightness2, const float opacity=1.0f)
- template<typename t>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const int tx2, const int ty2, const float opacity=1.0f, const float brightness=1.0f)

  *Draw a 2D textured triangle in the instance image, at coordinates (*x0,y0*)-(*x1,y1*)-(*x2,y2*).*

- template<typename t>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const float z0, const int x1, const int y1, const float z1, const int x2, const int y2, const float z2, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const int tx2, const int ty2, const float opacity=1.0f, const float brightness=1.0f)

  Draw a textured triangle with perspective correction.

- template<typename tc, typename t>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const tc *const color, const **CImg**< t > &light, const int lx0, const int ly0, const int lx1, const int ly1, const int lx2, const int ly2, const float opacity=1.0f)

  *Draw a 2D phong-shaded triangle in the instance image, at coordinates (*x0,y0*)-(*x1,y1*)-(*x2,y2*).*

- template<typename tc, typename t>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< tc > &color, const **CImg**< t > &light, const int lx0, const int ly0, const int lx1, const int ly1, const int lx2, const int ly2, const float opacity=1.0f)
- template<typename t>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const int tx2, const int ty2, const float brightness0, const float brightness1, const float brightness2, const float opacity=1)

  *Draw a 2D textured triangle with Gouraud-Shading in the instance image, at coordinates (*x0,y0*)-(*x1,y1*)-(*x2,y2*).*

- template<typename t>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const float z0, const int x1, const int y1, const float z1, const int x2, const int y2, const float z2, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const int tx2, const int ty2, const float c0, const float c1, const float c2, const float opacity=1.0f)

  Draw a gouraud + textured triangle with perspective correction.

- template<typename t, typename tl>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const int x1, const int y1, const int x2, const int y2, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const int tx2, const int ty2, const **CImg**< tl > &light, const int lx0, const int ly0, const int lx1, const int ly1, const int lx2, const int ly2, const float opacity=1.0f)

  Draw a phong-shaded 2D textured triangle in the instance image, at coordinates (`x0,y0`*)-(*`x1,y1`*)-(*`x2,y2`*).*

- template<typename t, typename tl>
  CImg< T > & **draw_triangle** (const int x0, const int y0, const float z0, const int x1, const int y1, const float z1, const int x2, const int y2, const float z2, const **CImg**< t > &texture, const int tx0, const int ty0, const int tx1, const int ty1, const int tx2, const int ty2, const **CImg**< tl > &light, const int lx0, const int ly0, const int lx1, const int ly1, const int lx2, const int ly2, const float opacity=1.0f)

  Draw a phong + textured triangle with perspective correction.

- template<typename tc>
  CImg< T > & **_draw_ellipse** (const int x0, const int y0, const float r1, const float r2, const float ru, const float rv, const tc *const color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const float r1, const float r2, const float ru, const float rv, const tc *const color, const float opacity, const unsigned int pattern)

  Draw an outlined ellipse.

- template<typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const float r1, const float r2, const float ru, const float rv, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const float r1, const float r2, const float ru, const float rv, const tc *const color, const float opacity=1.0f)

  Draw a filled ellipse.

- template<typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const float r1, const float r2, const float ru, const float rv, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const **CImg**< t > &tensor, const tc *const color, const float opacity=1.0f)

  Draw a filled ellipse on the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const **CImg**< t > &tensor, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const **CImg**< t > &tensor, const tc *const color, const float opacity, const unsigned int pattern)

  Draw an outlined ellipse on the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_ellipse** (const int x0, const int y0, const **CImg**< t > &tensor, const **CImg**< tc > &color, const float opacity, const unsigned int pattern)
- template<typename tc>
  CImg< T > & **draw_circle** (const int x0, const int y0, int radius, const tc *const color, const float opacity=1.0f)

Draw a filled circle on the instance image.

- template<typename tc>
  CImg< T > & **draw_circle** (const int x0, const int y0, int radius, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_circle** (const int x0, const int y0, int radius, const tc *const color, const float opacity, const unsigned int)

  Draw an outlined circle.

- template<typename tc>
  CImg< T > & **draw_circle** (const int x0, const int y0, int radius, const **CImg**< tc > &color, const float opacity, const unsigned int foo)
- template<typename t>
  CImg< T > & **draw_text** (const char *const text, const int x0, const int y0, const T *const fgcolor, const T *const bgcolor, const **CImgList**< t > &font, const float opacity=1.0f)

  Draw a text into the instance image.

- template<typename tc, typename t>
  CImg< T > & **draw_text** (const char *const text, const int x0, const int y0, const **CImg**< tc > &fgcolor, const **CImg**< tc > &bgcolor, const **CImgList**< t > &font, const float opacity=1.0f)
- **CImg**< T > & **draw_text** (const char *const text, const int x0, const int y0, const T *const fgcolor, const T *const bgcolor=0, const unsigned int font_size=11, const float opacity=1.0f)

  Draw a text into the instance image.

- template<typename tc>
  CImg< T > & **draw_text** (const char *const text, const int x0, const int y0, const **CImg**< tc > &fgcolor, const **CImg**< tc > &bgcolor, const unsigned int font_size=11, const float opacity=1.0f)
- **CImg**< T > & **draw_text** (const int x0, const int y0, const T *const fgcolor, const T *const bgcolor, const unsigned int font_size, const float opacity, const char *format,...)

  Draw a text into the instance image.

- template<typename tc>
  CImg< T > & **draw_text** (const int x0, const int y0, const **CImg**< tc > &fgcolor, const **CImg**< tc > &bgcolor, const unsigned int font_size, const float opacity, const char *format,...)
- template<typename t>
  CImg< T > & **draw_text** (const int x0, const int y0, const T *const fgcolor, const T *const bgcolor, const **CImgList**< t > &font, const float opacity, const char *format,...)

  Draw a text into the instance image.

- template<typename tc, typename t>
  CImg< T > & **draw_text** (const int x0, const int y0, const **CImg**< tc > &fgcolor, const **CImg**< tc > &bgcolor, const **CImgList**< t > &font, const float opacity, const char *format,...)
- template<typename t1, typename t2>
  CImg< T > & **draw_quiver** (const **CImg**< t1 > &flow, const t2 *const color, const unsigned int sampling=25, const float factor=-20, const int quiver_type=0, const float opacity=1.0f, const unsigned int pattern=~0U)

  Draw a vector field in the instance image, using a colormap.

- template<typename t1, typename t2>
  CImg< T > & **draw_quiver** (const **CImg**< t1 > &flow, const **CImg**< t2 > &color, const unsigned int sampling=25, const float factor=-20, const int quiver_type=0, const float opacity=1.0f, const unsigned int pattern=~0U)

Draw a vector field in the instance image, using a colormap.

- template<typename t, typename tc>
  CImg< T > & **draw_graph** (const **CImg**< t > &**data**, const tc *const color, const unsigned int gtype=1, const double ymin=0, const double ymax=0, const float opacity=1.0f, const unsigned int pattern=~0U)

  Draw a 1D graph on the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_graph** (const **CImg**< t > &**data**, const **CImg**< tc > &color, const unsigned int gtype=1, const double ymin=0, const double ymax=0, const float opacity=1.0f, const unsigned int pattern=~0U)
- template<typename t, typename tc>
  CImg< T > & **draw_axis** (const **CImg**< t > &xvalues, const int y, const tc *const color, const float opacity=1.0f, const unsigned int pattern=~0U)

  Draw a labeled horizontal axis on the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_axis** (const **CImg**< t > &xvalues, const int y, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int pattern=~0U)
- template<typename t, typename tc>
  CImg< T > & **draw_axis** (const int x, const **CImg**< t > &yvalues, const tc *const color, const float opacity=1.0f, const unsigned int pattern=~0U)

  Draw a labeled vertical axis on the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_axis** (const int x, const **CImg**< t > &yvalues, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int pattern=~0U)
- template<typename tx, typename ty, typename tc>
  CImg< T > & **draw_axis** (const **CImg**< tx > &xvalues, const **CImg**< ty > &yvalues, const tc *const color, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)

  Draw a labeled horizontal+vertical axis on the instance image.

- template<typename tx, typename ty, typename tc>
  CImg< T > & **draw_axis** (const **CImg**< tx > &xvalues, const **CImg**< ty > &yvalues, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)
- template<typename tc>
  CImg< T > & **draw_axis** (const float x0, const float x1, const float y0, const float y1, const tc *const color, const int subdivisionx=-60, const int subdivisiony=-60, const float precisionx=0, const float precisiony=0, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)

  Draw a labeled horizontal+vertical axis on the instance image.

- template<typename tc>
  CImg< T > & **draw_axis** (const float x0, const float x1, const float y0, const float y1, const **CImg**< tc > &color, const int subdivisionx=-60, const int subdivisiony=-60, const float precisionx=0, const float precisiony=0, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)
- template<typename tx, typename ty, typename tc>
  CImg< T > & **draw_grid** (const **CImg**< tx > &xvalues, const **CImg**< ty > &yvalues, const

tc *const color, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)

Draw grid on the instance image.

- template<typename tx, typename ty, typename tc>
  CImg< T > & **draw_grid** (const **CImg**< tx > &xvalues, const **CImg**< ty > &yvalues, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)
- template<typename tc>
  CImg< T > & **draw_grid** (const float deltax, const float deltay, const float offsetx, const float offsety, const bool invertx, const bool inverty, const tc *const color, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)

  Draw grid on the instance image.

- template<typename tc>
  CImg< T > & **draw_grid** (const float deltax, const float deltay, const float offsetx, const float offsety, const bool invertx, const bool inverty, const **CImg**< tc > &color, const float opacity=1.0f, const unsigned int patternx=~0U, const unsigned int patterny=~0U)
- template<typename tc, typename t>
  CImg< T > & **draw_fill** (const int x, const int y, const int z, const tc *const color, **CImg**< t > &region, const float sigma=0, const float opacity=1.0f, const bool high_connexity=false)

  *Draw a 3D filled region starting from a point (*x,y,\ z*) in the instance image.*

- template<typename tc, typename t>
  CImg< T > & **draw_fill** (const int x, const int y, const int z, const **CImg**< tc > &color, **CImg**< t > &region, const float sigma=0, const float opacity=1.0f, const bool high_connexity=false)
- template<typename tc>
  CImg< T > & **draw_fill** (const int x, const int y, const int z, const tc *const color, const float sigma=0, const float opacity=1.0f, const bool high_connexity=false)

  *Draw a 3D filled region starting from a point (*x,y,\ z*) in the instance image.*

- template<typename tc>
  CImg< T > & **draw_fill** (const int x, const int y, const int z, const **CImg**< tc > &color, const float sigma=0, const float opacity=1.0f, const bool high_connexity=false)
- template<typename tc>
  CImg< T > & **draw_fill** (const int x, const int y, const tc *const color, const float sigma=0, const float opacity=1.0f, const bool high_connexity=false)

  *Draw a 2D filled region starting from a point (*x,y*) in the instance image.*

- template<typename tc>
  CImg< T > & **draw_fill** (const int x, const int y, const **CImg**< tc > &color, const float sigma=0, const float opacity=1.0f, const bool high_connexity=false)
- **CImg**< T > & **draw_plasma** (const int x0, const int y0, const int x1, const int y1, const double alpha=1.0, const double beta=1.0, const float opacity=1.0f)

  Draw a plasma square in the instance image.

- **CImg**< T > & **draw_plasma** (const double alpha=1.0, const double beta=1.0, const float opacity=1.0f)

  Draw a plasma in the instance image.

- template<typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const double sigma, const tc *const color, const float opacity=1.0f)

  Draw a 1D gaussian function in the instance image.

- template<typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const double sigma, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const **CImg**< t > &tensor, const tc *const color, const float opacity=1.0f)

  Draw an anisotropic 2D gaussian function in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const **CImg**< t > &tensor, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const float sigma, const tc *const color, const float opacity=1.0f)

  Draw an isotropic 2D gaussian function in the instance image.

- template<typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const float sigma, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename t, typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const float zc, const **CImg**< t > &tensor, const tc *const color, const float opacity=1.0f)

  Draw an anisotropic 3D gaussian function in the instance image.

- template<typename t, typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const float zc, const **CImg**< t > &tensor, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const float zc, const double sigma, const tc *const color, const float opacity=1.0f)

  Draw an isotropic 3D gaussian function in the instance image.

- template<typename tc>
  CImg< T > & **draw_gaussian** (const float xc, const float yc, const float zc, const double sigma, const **CImg**< tc > &color, const float opacity=1.0f)
- template<typename tp, typename tf, typename tc, typename to>
  CImg< T > & **draw_object3d** (const float X, const float Y, const float Z, const **CImg**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImgList**< to > &opacities, const unsigned int render_type=4, const bool double_sided=false, const float focale=500, const float lightx=0, const float lighty=0, const float lightz=-5000, const float specular_light=0.2f, const float specular_shine=0.1f)

  Draw a 3D object in the instance image.

- template<typename tp, typename tf, typename tc, typename to>
  CImg< T > & **draw_object3d** (const float X, const float Y, const float Z, const **CImgList**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImgList**<

to > &opacities, const unsigned int render_type=4, const bool double_sided=false, const float focale=500, const float lightx=0, const float lighty=0, const float lightz=-5000, const float specular_light=0.2f, const float specular_shine=0.1f)

Draw a 3D object in the instance image.

- template<typename tp, typename tf, typename tc, typename to>
CImg< T > & **draw_object3d** (const float X, const float Y, const float Z, const **CImg**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImg**< to > &opacities, const unsigned int render_type=4, const bool double_sided=false, const float focale=500, const float lightx=0, const float lighty=0, const float lightz=-5000, const float specular_light=0.2f, const float specular_shine=0.1f)

  Draw a 3D object in the instance image.

- template<typename tp, typename tf, typename tc, typename to>
CImg< T > & **draw_object3d** (const float X, const float Y, const float Z, const **CImgList**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImg**< to > &opacities, const unsigned int render_type=4, const bool double_sided=false, const float focale=500, const float lightx=0, const float lighty=0, const float lightz=-5000, const float specular_light=0.2f, const float specular_shine=0.1f)

  Draw a 3D object in the instance image.

- template<typename tp, typename tf, typename tc>
CImg< T > & **draw_object3d** (const float X, const float Y, const float Z, const tp &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const unsigned int render_type=4, const bool double_sided=false, const float focale=500, const float lightx=0, const float lighty=0, const float lightz=-5000, const float specular_light=0.2f, const float specular_shine=0.1f, const float opacity=1.0f)

  Draw a 3D object in the instance image.

Image Filtering

- template<typename t>
CImg< typename cimg::superset2< T, t, float >::type > **get_correlate** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_correl=false) const

  Compute the correlation of the instance image by a mask.

- template<typename t>
CImg< T > & **correlate** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_correl=false)

  In-place version of the previous function.

- template<typename t>
CImg< typename cimg::superset2< T, t, float >::type > **get_convolve** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_convol=false) const

  Return the convolution of the image by a mask.

- template<typename t>
CImg< T > & **convolve** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_convol=false)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_erode** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_erosion=false) const

  Return the erosion of the image by a structuring element.

- template<typename t>
  CImg< T > & **erode** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_erosion=false)

  In-place version of the previous function.

- **CImg**< T > **get_erode** (const unsigned int n, const unsigned int cond=1) const

  Erode the image by a square structuring element of size n.

- **CImg**< T > & **erode** (const unsigned int n, const unsigned int cond=1)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_dilate** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_dilatation=false) const

  Return the dilatation of the image by a structuring element.

- template<typename t>
  CImg< T > & **dilate** (const **CImg**< t > &mask, const unsigned int cond=1, const bool weighted_dilatation=false)
- **CImg**< T > **get_dilate** (const unsigned int n, const unsigned int cond=1) const

  Dilate the image by a square structuring element of size n.

- **CImg**< T > & **dilate** (const unsigned int n, const unsigned int cond=1)

  In-place version of the previous function.

- **CImg**< T > **get_noise** (const double sigma=-20, const unsigned int ntype=0) const

  Add noise to the image.

- **CImg**< T > & **noise** (const double sigma=-20, const unsigned int ntype=0)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_deriche** (const float sigma, const int order=0, const char axe='x', const bool cond=true) const

  Return the result of the Deriche filter.

- **CImg**< T > & **deriche** (const float sigma, const int order=0, const char axe='x', const bool cond=true)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_blur** (const float sigmax, const float sigmay, const float sigmaz, const bool cond=true) const

  Return a blurred version of the image, using a Canny-Deriche filter.

- **CImg**< T > & **blur** (const float sigmax, const float sigmay, const float sigmaz, const bool cond=true)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_blur** (const float sigma, const bool cond=true) const

  Return a blurred version of the image, using a Canny-Deriche filter.

- **CImg**< T > & **blur** (const float sigma, const bool cond=true)

  In-place version of the previous function.

- template<typename t>
  CImg< T > **get_blur_anisotropic** (const **CImg**< t > &G, const float amplitude=60.0f, const float dl=0.8f, const float da=30.0f, const float gauss_prec=2.0f, const unsigned int interpolation=0, const bool fast_approx=true) const

  Get a blurred version of an image following a field of diffusion tensors.

- template<typename t>
  CImg< T > & **blur_anisotropic** (const **CImg**< t > &G, const float amplitude=60.0f, const float dl=0.8f, const float da=30.0f, const float gauss_prec=2.0f, const unsigned int interpolation=0, const bool fast_approx=true)

  In-place version of the previous function.

- template<typename tm>
  CImg< T > **get_blur_anisotropic** (const **CImg**< tm > &mask, const float amplitude, const float sharpness=0.7f, const float anisotropy=0.3f, const float alpha=0.6f, const float sigma=1.1f, const float dl=0.8f, const float da=30.0f, const float gauss_prec=2.0f, const unsigned int interpolation=0, const bool fast_approx=true, const float geom_factor=1.0f) const

  Blur an image in an anisotropic way.

- template<typename tm>
  CImg< T > & **blur_anisotropic** (const **CImg**< tm > &mask, const float amplitude, const float sharpness=0.7f, const float anisotropy=0.3f, const float alpha=0.6f, const float sigma=1.1f, const float dl=0.8f, const float da=30.0f, const float gauss_prec=2.0f, const unsigned int interpolation=0, const bool fast_approx=true, const float geom_factor=1.0f)

  In-place version of the previous function.

- **CImg**< T > **get_blur_anisotropic** (const float amplitude, const float sharpness=0.7f, const float anisotropy=0.3f, const float alpha=0.6f, const float sigma=1.1f, const float dl=0.8f, const float da=30.0f, const float gauss_prec=2.0f, const unsigned int interpolation=0, const bool fast_approx=true, const float geom_factor=1.0f) const

  Blur an image following in an anisotropic way.

- **CImg**< T > & **blur_anisotropic** (const float amplitude, const float sharpness=0.7f, const float anisotropy=0.3f, const float alpha=0.6f, const float sigma=1.1f, const float dl=0.8f, const float da=30.0f, const float gauss_prec=2.0f, const unsigned int interpolation=0, const bool fast_approx=true, const float geom_factor=1.0f)

  In-place version of the previous function.

- **CImg**< T > **get_blur_bilateral** (const float sigmax, const float sigmay, const float sigmaz, const float sigmar, const int bgridx, const int bgridy, const int bgridz, const int bgridr, const bool interpolation=true) const

  Blur an image using the bilateral filter.

- **CImg**< T > & **blur_bilateral** (const float sigmax, const float sigmay, const float sigmaz, const float sigmar, const int bgridx, const int bgridy, const int bgridz, const int bgridr, const bool interpolation=true)

  In-place version of the previous function.

- **CImg**< T > **get_blur_bilateral** (const float sigmas, const float sigmar, const int bgrids=-33, const int bgridr=32, const bool interpolation=true) const

  Blur an image using the bilateral filter.

- **CImg**< T > & **blur_bilateral** (const float sigmas, const float sigmar, const int bgrids=-33, const int bgridr=32, const bool interpolation=true)

  In-place version of the previous function.

- **CImg**< T > **get_blur_patch** (const unsigned int patch_size=3, const float sigma_p=10.0f, const float sigma_s=10.0f, const unsigned int lookup_size=4, const bool fast_approx=true) const

  Blur an image in its patch-based space.

- **CImg**< T > & **blur_patch** (const unsigned int patch_size=3, const float sigma_p=10.0f, const float sigma_s=10.0f, const unsigned int lookup_size=4, const bool fast_approx=true)

  Blur an image in its patch-based space.

- **CImgList**< typename cimg::superset< T, float >::type > **get_FFT** (const char axe, const bool invert=false) const

  Return the Fast Fourier Transform of an image (along a specified axis).

- **CImgList**< typename cimg::superset< T, float >::type > **get_FFT** (const bool invert=false) const

  Return the Fast Fourier Transform on an image.

- **CImg**< T > **get_blur_median** (const unsigned int n=3)

  Apply a median filter.

- **CImg**< T > & **blur_median** (const unsigned int n=3)

  In-place version of the previous function.

- **CImg**< T > **get_sharpen** (const float amplitude=50.0f, const float edge=1.0f, const float alpha=0.0f, const float sigma=0.0f) const

  Sharpen image using anisotropic shock filters.

- **CImg**< T > & **sharpen** (const float amplitude=50.0f, const float edge=1.0f, const float alpha=0.0f, const float sigma=0.0f)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_haar** (const char axis, const bool invert=false, const unsigned int nb_scales=1) const

  Compute the Haar multiscale wavelet transform (monodimensional version).

- **CImg**< T > & **haar** (const char axis, const bool invert=false, const unsigned int nb_scales=1)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_haar** (const bool invert=false, const unsigned int nb_scales=1) const

Compute the Haar multiscale wavelet transform.

- **CImg**< T > & **haar** (const bool invert=false, const unsigned int nb_scales=1)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_displacement_field** (const **CImg**< T > &target, const float smoothness=0.1f, const float precision=0.1f, const unsigned int nb_scales=0, const unsigned int itermax=10000) const

  Estimate a displacement field between instance image and given target image.

- **CImg**< T > & **displacement_field** (const **CImg**< T > &target, const float smooth=0.1f, const float precision=0.1f, const unsigned int nb_scales=0, const unsigned int itermax=10000)

  In-place version of the previous function.

Matrix and Vectors

- **CImg**< T > **get_vector_at** (const unsigned int x=0, const unsigned int y=0, const unsigned int z=0) const

  *Return a new image corresponding to the vector located at (*x,y,z*) of the current vector-valued image.*

- template<typename t>
  CImg< T > & **set_vector_at** (const **CImg**< t > &vec, const unsigned int x=0, const unsigned int y=0, const unsigned int z=0)

  Set the image vec *as the* vector valued *pixel located at (*x,y,z*) of the current vector-valued image.*

- **CImg**< T > **get_matrix_at** (const unsigned int x=0, const unsigned int y=0, const unsigned int z=0) const

  Return a new image corresponding to the square matrix *located at (*x,y,z*) of the current vector-valued image.*

- template<typename t>
  CImg< T > & **set_matrix_at** (const **CImg**< t > &mat, const unsigned int x=0, const unsigned int y=0, const unsigned int z=0)

  Set the image vec *as the* square matrix-valued *pixel located at (*x,y,z*) of the current vector-valued image.*

- **CImg**< T > **get_tensor_at** (const unsigned int x=0, const unsigned int y=0, const unsigned int z=0) const

  Return a new image corresponding to the diffusion tensor *located at (*x,y,z*) of the current vector-valued image.*

- template<typename t>
  CImg< T > & **set_tensor_at** (const **CImg**< t > &ten, const unsigned int x=0, const unsigned int y=0, const unsigned int z=0)

  Set the image vec *as the* tensor valued *pixel located at (*x,y,z*) of the current vector-valued image.*

- **CImg**< T > **get_vector** () const

  Unroll all images values into a one-column vector.

- **CImg**< T > & **vector** ()

  In-place version of the previous function.

- **CImg**< T > **get_matrix** () const

  Realign pixel values of the instance image as a square matrix.

- **CImg**< T > & **matrix** ()

  In-place version of the previous function.

- **CImg**< T > **get_tensor** () const

  Realign pixel values of the instance image as a symmetric tensor.

- **CImg**< T > & **tensor** ()

  In-place version of the previous function.

- **CImg**< T > **get_unroll** (const char axe='x') const

  Unroll all images values into specified axis.

- **CImg**< T > & **unroll** (const char axe='x')

  In-place version of the previous function.

- **CImg**< T > **get_diagonal** () const

  Get a diagonal matrix, whose diagonal coefficients are the coefficients of the input image.

- **CImg**< T > & **diagonal** ()

  In-place version of the previous function.

- **CImg**< T > **get_identity_matrix** () const

  Get an identity matrix having same dimension than instance image.

- **CImg**< T > & **identity_matrix** ()

  In-place version of the previous function.

- **CImg**< T > **get_sequence** (const T a0, const T a1) const

  Return a N-numbered sequence vector from `a0` *to* `a1`.

- **CImg**< T > & **sequence** (const T a0, const T a1)

  In-place version of the previous function.

- **CImg**< T > **get_transpose** () const

  Return the transpose version of the current matrix.

- **CImg**< T > & **transpose** ()

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_invert** (const bool use_LU=true) const

  Return the inverse of the current matrix.

- **CImg**< T > & **invert** (const bool use_LU=true)

  In-place version of the previous function.

- **CImg**< typename cimg::superset< T, float >::type > **get_pseudoinvert** () const

Return the pseudo-inverse (Moore-Penrose) of the matrix.

- **CImg**< T > & **pseudoinvert** ()

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset< T, t >::type > **get_cross** (const **CImg**< t > &img) const

  Compute the cross product between two 3d vectors.

- template<typename t>
  CImg< T > & **cross** (const **CImg**< t > &img)

  In-place version of the previous function.

- template<typename t>
  CImg< typename cimg::superset2< T, t, float >::type > **get_solve** (const **CImg**< t > &A) const

  Solve a linear system AX=B where B=∗this.

- template<typename t>
  CImg< T > & **solve** (const **CImg**< t > &A)

  In-place version of the previous function.

- template<typename t, typename ti>
  CImg< T > & **_solve** (const **CImg**< t > &A, const **CImg**< ti > &indx)
- template<typename t>
  CImg< T > **get_sort** (**CImg**< t > &permutations, const bool increasing=true) const

  Sort values of a vector and get permutations.

- template<typename t>
  CImg< T > & **sort** (**CImg**< t > &permutations, const bool increasing=true)

  In-place version of the previous function.

- **CImg**< T > **get_sort** (const bool increasing=true) const
- **CImg**< T > & **sort** (const bool increasing=true)

  In-place version of the previous function.

- template<typename t>
  CImg< T > & **_quicksort** (const int min, const int max, **CImg**< t > &permutations, const bool increasing)
- template<typename t>
  CImg< T > **get_permute** (const **CImg**< t > &permutation) const

  Get a permutation of the pixels.

- template<typename t>
  CImg< T > & **permute** (const **CImg**< t > &permutation)

  In-place version of the previous function.

- template<typename t>
  const **CImg**< T > & **SVD** (**CImg**< t > &U, **CImg**< t > &S, **CImg**< t > &V, const bool sorting=true, const unsigned int max_iter=40, const float lambda=0) const

  Compute the SVD of a general matrix.

- template<typename t>
  const **CImg**< T > & **SVD** (**CImgList**< t > &USV) const

  Compute the SVD of a general matrix.

- **CImgList**< typename cimg::superset< T, float >::type > **get_SVD** (const bool sorting=true) const

  Compute the SVD of a general matrix.

- template<typename t>
  CImg< T > & **_LU** (**CImg**< t > &indx, bool &d)
- **CImgList**< typename cimg::superset< T, float >::type > **get_eigen** () const

  Return the eigenvalues and eigenvectors of a matrix.

- template<typename t>
  const **CImg**< T > & **eigen** (**CImg**< t > &val, **CImg**< t > &vec) const

  Compute the eigenvalues and eigenvectors of a matrix.

- **CImgList**< typename cimg::superset< T, float >::type > **get_symmetric_eigen** () const

  Compute the eigenvalues and eigenvectors of a symmetric matrix.

- template<typename t>
  const **CImg**< T > & **symmetric_eigen** (**CImg**< t > &val, **CImg**< t > &vec) const

  Compute the eigenvalues and eigenvectors of a symmetric matrix.

- static **CImg**< T > **vector** (const T a0)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8)

Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11, const T a12)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11, const T a12, const T a13)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11, const T a12, const T a13, const T a14)

  Return a vector with specified coefficients.

- static **CImg**< T > **vector** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11, const T a12, const T a13, const T a14, const T a15)

  Return a vector with specified coefficients.

- template<int N>
  static **CImg**< T > **vector** (const int a0, const int a1,...)

  Return a vector with specified coefficients.

- template<int N>
  static **CImg**< T > **vector** (const double a0, const double a1,...)

  Return a vector with specified coefficients.

- static **CImg**< T > **matrix** (const T a0)

  Return a 1x1 square matrix with specified coefficients.

- static **CImg**< T > **matrix** (const T a0, const T a1, const T a2, const T a3)

  Return a 2x2 square matrix with specified coefficients.

- static **CImg**< T > **matrix** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8)

  Return a 3x3 square matrix with specified coefficients.

- static **CImg**< T > **matrix** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11, const T a12, const T a13, const T a14, const T a15)

  Return a 4x4 square matrix with specified coefficients.

- static **CImg**< T > **matrix** (const T a0, const T a1, const T a2, const T a3, const T a4, const T a5, const T a6, const T a7, const T a8, const T a9, const T a10, const T a11, const T a12, const T a13, const T a14, const T a15, const T a16, const T a17, const T a18, const T a19, const T a20, const T a21, const T a22, const T a23, const T a24)

  Return a 5x5 square matrix with specified coefficients.

- template<int M, int N>
  static **CImg**< T > **matrix** (const int a0, const int a1,...)

  Return a MxN square matrix with specified coefficients.

- template<int M, int N>
  static **CImg**< T > **matrix** (const double a0, const double a1,...)

  Return a NxN square matrix with specified coefficients.

- static **CImg**< T > **tensor** (const T a1)

  Return a 1x1 symmetric matrix with specified coefficients.

- static **CImg**< T > **tensor** (const T a1, const T a2, const T a3)

  Return a 2x2 symmetric matrix tensor with specified coefficients.

- static **CImg**< T > **tensor** (const T a1, const T a2, const T a3, const T a4, const T a5, const T a6)

  Return a 3x3 symmetric matrix with specified coefficients.

- static **CImg**< T > **diagonal** (const T a0)

  Return a 1x1 diagonal matrix with specified coefficients.

- static **CImg**< T > **diagonal** (const T a0, const T a1)

  Return a 2x2 diagonal matrix with specified coefficients.

- static **CImg**< T > **diagonal** (const T a0, const T a1, const T a2)

  Return a 3x3 diagonal matrix with specified coefficients.

- static **CImg**< T > **diagonal** (const T a0, const T a1, const T a2, const T a3)

  Return a 4x4 diagonal matrix with specified coefficients.

- static **CImg**< T > **diagonal** (const T a0, const T a1, const T a2, const T a3, const T a4)

  Return a 5x5 diagonal matrix with specified coefficients.

- template<int N>
  static **CImg**< T > **diagonal** (const int a0,...)

  Return a NxN diagonal matrix with specified coefficients.

- template<int N>
  static **CImg**< T > **diagonal** (const double a0,...)

  Return a NxN diagonal matrix with specified coefficients.

- static **CImg**< T > **identity_matrix** (const unsigned int N)

  Return a NxN identity matrix.

- static **CImg**< T > **sequence** (const unsigned int N, const T a0, const T a1)

  Return a N-numbered sequence vector from `a0` *to* `a1`.

- static **CImg**< T > **rotation_matrix** (const float x, const float y, const float z, const float w, const bool quaternion_data=false)

  Return a 3x3 rotation matrix along the (x,y,z)-axis with an angle w.

Display

- const **CImg**< T > & **display** (**CImgDisplay** &disp) const

  Display an image into a ***CImgDisplay*** (p. *135) window.*

- const **CImg**< T > & **display** (const char *const title, const int min_size=128, const int max_size=1024, const int print_flag=1) const

  Display an image in a window with a title `title`*, and wait a 'is_closed' or 'keyboard' event.*
  Parameters `min_size` *and* `max_size` *set the minimum and maximum dimensions of the display window. If negative, they corresponds to a percentage of the original image size.*

- const **CImg**< T > & **display** (const int min_size=128, const int max_size=1024, const int print_flag=1) const

  Display an image in a window, with a default title. See also.

- **CImg**< typename cimg::last< T, int >::type > **get_coordinates** (const int coords_type, **CImgDisplay** &disp, unsigned int *const XYZ=0, const unsigned char *const color=0) const

  Simple interface to select shaped from an image.

- **CImg**< typename cimg::last< T, int >::type > **get_coordinates** (const int coords_type=0, unsigned int *const XYZ=0, const unsigned char *const color=0) const

  High-level interface to select features in images.

- **CImg**< T > & **coordinates** (const int coords_type=0, unsigned int *const XYZ=0, const unsigned char *const color=0)
- template<typename tp, typename tf, typename tc, typename to>
  const **CImg**< T > & **display_object3d** (const **CImg**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImgList**< to > &opacities, **CImgDisplay** &disp, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0) const

  High-level interface for displaying a 3d object.

- template<typename tp, typename tf, typename tc, typename to>
  const **CImg**< T > & **display_object3d** (const **CImgList**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImgList**< to > &opacities, **CImgDisplay** &disp, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0) const

High-level interface for displaying a 3d object.

- template<typename tp, typename tf, typename tc, typename to>
  const **CImg**< T > & **display_object3d** (const **CImg**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImg**< to > &opacities, **CImgDisplay** &disp, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0) const

  High-level interface for displaying a 3d object.

- template<typename tp, typename tf, typename tc, typename to>
  const **CImg**< T > & **display_object3d** (const **CImgList**< tp > &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const **CImg**< to > &opacities, **CImgDisplay** &disp, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0) const

  High-level interface for displaying a 3d object.

- template<typename tp, typename tf, typename tc, typename to>
  const **CImg**< T > & **display_object3d** (const tp &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const to &opacities, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0) const

  High-level interface for displaying a 3d object.

- template<typename tp, typename tf, typename tc>
  const **CImg**< T > & **display_object3d** (const tp &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0, const float opacity=1.0f) const

  High-level interface for displaying a 3d object.

- template<typename tp, typename tf, typename tc>
  const **CImg**< T > & **display_object3d** (const tp &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, **CImgDisplay** &disp, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0, const float opacity=1.0f) const

  High-level interface for displaying a 3d object.

Input-Output

- **CImg**< T > & **load** (const char *const filename)
- **CImg**< T > & **load_ascii** (std::FILE *const file, const char *const filename=0)
- **CImg**< T > & **load_ascii** (const char *const filename)
- **CImg**< T > & **load_dlm** (std::FILE *const file, const char *const filename=0)
- **CImg**< T > & **load_dlm** (const char *const filename)
- **CImg**< T > & **load_pnm** (std::FILE *const file, const char *const filename=0)
- **CImg**< T > & **load_pnm** (const char *const filename)

- **CImg**< T > & **load_bmp** (std::FILE *const file, const char *const filename=0)
- **CImg**< T > & **load_bmp** (const char *const filename)
- **CImg**< T > & **load_png** (std::FILE *const file, const char *const filename=0)
- **CImg**< T > & **load_png** (const char *const filename)
- **CImg**< T > & **load_tiff** (const char *const filename, const unsigned int first_frame=0, const unsigned int last_frame=~0U)
- **CImg**< T > & **load_jpeg** (std::FILE *const file, const char *const filename=0)
- **CImg**< T > & **load_jpeg** (const char *const filename)
- **CImg**< T > & **load_magick** (const char *const filename)
- **CImg**< T > & **load_raw** (std::FILE *const file, const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int sizez=1, const unsigned int sizev=1, const bool multiplexed=false, const bool endian_swap=false)
- **CImg**< T > & **load_raw** (const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int sizez=1, const unsigned int sizev=1, const bool multiplexed=false, const bool endian_swap=false)
- **CImg**< T > & **load_rgba** (std::FILE *const file, const char *const filename, const unsigned int dimw, const unsigned int dimh)
- **CImg**< T > & **load_rgba** (const char *const filename, const unsigned int dimw, const unsigned int dimh)
- **CImg**< T > & **load_rgb** (std::FILE *const file, const char *const filename, const unsigned int dimw, const unsigned int dimh)
- **CImg**< T > & **load_rgb** (const char *const filename, const unsigned int dimw, const unsigned int dimh)
- **CImg**< T > & **load_inr** (std::FILE *const file, const char *const filename=0, float *const voxsize=0)
- **CImg**< T > & **load_inr** (const char *const filename, float *const voxsize=0)
- **CImg**< T > & **load_pandore** (std::FILE *const file, const char *const filename)
- **CImg**< T > & **load_pandore** (const char *const filename)
- **CImg**< T > & **load_analyze** (const char *const filename, float *const voxsize=0)
- template<typename tf, typename tc>
  CImg< T > & **load_off** (const char *const filename, **CImgList**< tf > &primitives, **CImgList**< tc > &colors, const bool invert_faces=false)
- **CImg**< T > & **load_dicom** (const char *const filename)
- **CImg**< T > & **load_imagemagick** (const char *const filename)
- **CImg**< T > & **load_graphicsmagick** (const char *const filename)
- **CImg**< T > & **load_other** (const char *const filename)
- **CImg**< T > & **load_parrec** (const char *const filename, const char axis='v', const char align='p')
- **CImg**< T > & **load_cimg** (std::FILE *const file, const char axis='z', const char align='p')
- **CImg**< T > & **load_cimg** (const char *const filename, const char axis='z', const char align='p')
- **CImg**< T > & **load_cimg** (std::FILE *const file, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1, const char axis='z', const char align='p')
- **CImg**< T > & **load_cimg** (const char *const filename, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1, const char axis='z', const char align='p')
- **CImg**< T > & **load_yuv** (std::FILE *const file, const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false, const char axis='z', const char align='p')

- **CImg**< T > & **load_yuv** (const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false, const char axis='z', const char align='p')
- **CImg**< T > & **load_ffmpeg** (const char *const filename, const char axis='z', const char align='p')

  In-place version of the previous function.

- const **CImg**< T > & **save** (const char *const filename, const int number=-1) const

  Save the image as a file.

- const **CImg**< T > & **save_ascii** (std::FILE *const file, const char *const filename=0) const

  Save the image as an ASCII file (ASCII Raw + simple header).

- const **CImg**< T > & **save_ascii** (const char *const filename) const

  Save the image as an ASCII file (ASCII Raw + simple header).

- const **CImg**< T > & **save_dlm** (std::FILE *const file, const char *const filename=0) const

  Save the image as a DLM file.

- const **CImg**< T > & **save_dlm** (const char *const filename) const

  Save the image as a DLM file.

- const **CImg**< T > & **save_pnm** (std::FILE *const file, const char *const filename=0) const

  Save the image as a PNM file.

- const **CImg**< T > & **save_pnm** (const char *const filename) const

  Save the image as a PNM file.

- const **CImg**< T > & **save_dicom** (const char *const filename) const

  Save an image as a Dicom file (need '(X)Medcon' : `http://xmedcon.sourceforge.net` *).*

- const **CImg**< T > & **save_analyze** (const char *const filename, const float *const voxsize=0) const

  Save the image as an ANALYZE7.5 or NIFTI file.

- const **CImg**< T > & **save_cimg** (std::FILE *const file, const char *const filename=0) const

  *Save the image as a **.cimg** (p. 20) file.*

- const **CImg**< T > & **save_cimg** (const char *const filename) const

  *Save the image as a **.cimg** (p. 20) file.*

- const **CImg**< T > & **save_cimg** (std::FILE *const file, const unsigned int n0, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0) const

  *Insert the image into an existing **.cimg** (p. 20) file, at specified coordinates.*

- const **CImg**< T > & **save_cimg** (const char *const filename, const unsigned int n0, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0) const

  *Insert the image into an existing **.cimg** (p. 20) file, at specified coordinates.*

- const **CImg**< T > & **save_raw** (std::FILE *const file, const char *const filename=0, const bool multiplexed=false) const

Save the image as a RAW file.

- const **CImg**< T > & **save_raw** (const char *const filename=0, const bool multiplexed=false) const

  Save the image as a RAW file.

- const **CImg**< T > & **save_imagemagick** (const char *const filename, const unsigned int quality=100) const

  Save the image using ImageMagick's convert.

- const **CImg**< T > & **save_graphicsmagick** (const char *const filename, const unsigned int quality=100) const

  Save the image using GraphicsMagick's gm.

- const **CImg**< T > & **save_other** (const char *const filename, const unsigned int quality=100) const

- const **CImg**< T > & **save_inr** (std::FILE *const file, const char *const filename=0, const float *const voxsize=0) const

  Save the image as an INRIMAGE-4 file.

- const **CImg**< T > & **save_inr** (const char *const filename, const float *const voxsize=0) const

  Save the image as an INRIMAGE-4 file.

- unsigned int **_save_pandore_header_length** (unsigned int id, unsigned int *dims, const unsigned int colorspace=0) const
- const **CImg**< T > & **save_pandore** (std::FILE *const file, const char *const filename=0, const unsigned int colorspace=0) const

  Save the image as a PANDORE-5 file.

- const **CImg**< T > & **save_pandore** (const char *const filename=0, const unsigned int colorspace=0) const

  Save the image as a PANDORE-5 file.

- const **CImg**< T > & **save_yuv** (std::FILE *const file, const char *const filename=0, const bool rgb2yuv=true) const

  Save the image as a YUV video sequence file.

- const **CImg**< T > & **save_yuv** (const char *const filename, const bool rgb2yuv=true) const

  Save the image as a YUV video sequence file.

- const **CImg**< T > & **save_ffmpeg** (const char *const filename, const char *const codec="mpeg2video") const

  Save the image as a video sequence file, using the external tool 'ffmpeg'.

- const **CImg**< T > & **save_bmp** (std::FILE *const file, const char *const filename=0) const

  Save the image as a BMP file.

- const **CImg**< T > & **save_bmp** (const char *const filename) const

  Save the image as a BMP file.

- const **CImg**< T > & **save_png** (std::FILE *const file, const char *const filename=0) const

  Save an image to a PNG file.

- const **CImg**< T > & **save_png** (const char *const filename) const
  Save a file in PNG format.

- const **CImg**< T > & **save_tiff** (const char *const filename) const
  Save a file in TIFF format.

- const **CImg**< T > & **save_jpeg** (std::FILE *const file, const char *const filename=0, const unsigned int quality=100) const
  Save a file in JPEG format.

- const **CImg**< T > & **save_jpeg** (const char *const filename, const unsigned int quality=100) const
  Save a file in JPEG format.

- const **CImg**< T > & **save_magick** (const char *const filename) const
  Save the image using built-in ImageMagick++ library.

- const **CImg**< T > & **save_rgba** (std::FILE *const file, const char *const filename=0) const
  Save the image as a RGBA file.

- const **CImg**< T > & **save_rgba** (const char *const filename) const
  Save the image as a RGBA file.

- const **CImg**< T > & **save_rgb** (std::FILE *const file, const char *const filename=0) const
  Save the image as a RGB file.

- const **CImg**< T > & **save_rgb** (const char *const filename) const
  Save the image as a RGB file.

- template<typename tf, typename tc>
  const **CImg**< T > & **save_off** (std::FILE *const file, const char *const filename, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const bool invert_faces=false) const
  Save OFF files (GeomView 3D object files).

- template<typename tf, typename tc>
  const **CImg**< T > & **save_off** (const char *const filename, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const bool invert_faces=false) const
  Save OFF files (GeomView 3D object files).

- static **CImg**< T > **get_load** (const char *const filename)
  Load an image from a file.

- static **CImg**< T > **get_load_ascii** (std::FILE *const file, const char *const filename=0)
  Load an image from an ASCII file.

- static **CImg**< T > **get_load_ascii** (const char *const filename)
  Load an image from an ASCII file.

- static **CImg**< T > **get_load_dlm** (std::FILE *const file, const char *const filename=0)
  Load an image from a DLM file.

- static **CImg**< T > **get_load_dlm** (const char *const filename)
  Load an image from a DLM file.
- static **CImg**< T > **get_load_pnm** (std::FILE *const file, const char *const filename=0)
  Load an image from a PNM file.
- static **CImg**< T > **get_load_pnm** (const char *const filename)
  Load an image from a PNM file.
- static **CImg**< T > **get_load_bmp** (std::FILE *const file, const char *const filename=0)
  Load an image from a BMP file.
- static **CImg**< T > **get_load_bmp** (const char *const filename)
  Load an image from a BMP file.
- static **CImg**< T > **get_load_png** (std::FILE *const file, const char *const filename=0)
  Load an image from a PNG file.
- static **CImg**< T > **get_load_png** (const char *const filename)
  Load an image from a PNG file.
- static **CImg**< T > **get_load_tiff** (const char *const filename, const unsigned int first_frame=0, const unsigned int last_frame=~0U)
  Load an image from a TIFF file.
- static **CImg**< T > **get_load_jpeg** (std::FILE *const file, const char *const filename=0)
  Load an image from a JPEG file.
- static **CImg**< T > **get_load_jpeg** (const char *const filename)
  Load an image from a JPEG file.
- static **CImg**< T > **get_load_magick** (const char *const filename)
  Load an image using builtin ImageMagick++ Library.
- static **CImg**< T > **get_load_raw** (std::FILE *const file, const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int sizez=1, const unsigned int sizev=1, const bool multiplexed=false, const bool endian_swap=false)
  Load an image from a .RAW file.
- static **CImg**< T > **get_load_raw** (const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int sizez=1, const unsigned int sizev=1, const bool multiplexed=false, const bool endian_swap=false)
  Load an image from a .RAW file.
- static **CImg**< T > **get_load_rgba** (std::FILE *const file, const char *const filename, const unsigned int dimw, const unsigned int dimh)
  Load an image from a RGBA file.
- static **CImg**< T > **get_load_rgba** (const char *const filename, const unsigned int dimw, const unsigned int dimh)

Load an image from a RGBA file.

- static **CImg**< T > **get_load_rgb** (std::FILE *const file, const char *const filename, const unsigned int dimw, const unsigned int dimh)

  Load an image from a RGB file.

- static **CImg**< T > **get_load_rgb** (const char *const filename, const unsigned int dimw, const unsigned int dimh)

  Load an image from a RGB file.

- static **CImg**< T > **get_load_inr** (std::FILE *const file, const char *const filename=0, float *voxsize=0)

  Load an image from an INRIMAGE-4 file.

- static void **_load_inr** (std::FILE *file, int out[8], float *const voxsize=0)
- static **CImg**< T > **get_load_inr** (const char *const filename, float *const voxsize=0)

  Load an image from an INRIMAGE-4 file.

- static **CImg**< T > **get_load_pandore** (std::FILE *const file, const char *const filename=0)

  Load an image from a PANDORE file.

- static **CImg**< T > **get_load_pandore** (const char *const filename)

  Load an image from a PANDORE file.

- static **CImg**< T > **get_load_analyze** (const char *const filename, float *const voxsize=0)

  Load an image from an ANALYZE7.5/NIFTI file.

- template<typename tf, typename tc>
  static **CImg**< T > **get_load_off** (const char *const filename, **CImgList**< tf > &primitives, **CImgList**< tc > &colors, const bool invert_faces=false)

  Load a 3D object from a .OFF file (GeomView 3D object files).

- static **CImg**< T > **get_load_dicom** (const char *const filename)

  Load an image from a DICOM file.

- static **CImg**< T > **get_load_imagemagick** (const char *const filename)

  Load an image using ImageMagick's convert.

- static **CImg**< T > **get_load_graphicsmagick** (const char *const filename)

  Load an image using GraphicsMagick's convert.

- static **CImg**< T > **get_load_other** (const char *const filename)

  Load an image using ImageMagick's or GraphicsMagick's executables.

- static **CImg**< T > **get_load_parrec** (const char *const filename, const char axis='v', const char align='p')

  Load an image from a PAR-REC (Philips) file.

- static **CImg**< T > **get_load_cimg** (std::FILE *const file, const char axis='z', const char align='p')

  *Load an image (list) from a **.cimg** (p. 20) file.*

- static **CImg**< T > **get_load_cimg** (const char *const filename, const char axis='z', const char align='p')

  *Load an image (list) from a **.cimg** (p. 20) file.*

- static **CImg**< T > **get_load_cimg** (std::FILE *const file, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1, const char axis='z', const char align='p')

  *Load a sub-image (list) from a **.cimg** (p. 20) file.*

- static **CImg**< T > **get_load_cimg** (const char *const filename, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1, const char axis='z', const char align='p')

  *Load a sub-image (list) from a **.cimg** (p. 20) file.*

- static **CImg**< T > **get_load_yuv** (std::FILE *const file, const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false, const char axis='z', const char align='p')

  Load an image sequence from a YUV file.

- static **CImg**< T > **get_load_yuv** (const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false, const char axis='z', const char align='p')

  Load an image sequence from a YUV file.

- static **CImg**< T > **get_load_ffmpeg** (const char *const filename, const char axis='z', const char align='p')

  Load an image from a video file (MPEG,AVI) using the external tool 'ffmpeg'.

- static void **save_empty_cimg** (std::FILE *const file, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  *Save an empty **.cimg** (p. 20) file with specified dimensions.*

- static void **save_empty_cimg** (const char *const filename, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  *Save an empty **.cimg** (p. 20) file with specified dimensions.*

- static **CImg**< T > **get_logo40x38** ()

  Get a 40x38 color logo of a 'danger' item.

Public Types

- typedef T * **iterator**

  Iterator type for CImg<T>.

- typedef const T * **const_iterator**

  Const iterator type for CImg<T>.

- typedef T **value_type**

  Get value type.

Public Attributes

- unsigned int **width**

  Variable representing the width of the instance image (i.e. dimensions along the X-axis).

- unsigned int **height**

  Variable representing the height of the instance image (i.e. dimensions along the Y-axis).

- unsigned int **depth**

  Variable representing the depth of the instance image (i.e. dimensions along the Z-axis).

- unsigned int **dim**

  Variable representing the number of channels of the instance image (i.e. dimensions along the V-axis).

- bool **is_shared**

  Variable telling if pixel buffer of the instance image is shared with another one.

- T ∗ **data**

  Pointer to the first pixel of the pixel buffer.

4.1.1 Detailed Description

template<typename T> struct cimg_library::CImg< T >

Class representing an image (up to 4 dimensions wide), each pixel being of type `T`.

This is the main class of the CImg Library. It declares and constructs an image, allows access to its pixel values, and is able to perform various image operations.

Image representation

A CImg image is defined as an instance of the container **CImg** (p. 25)<T>, which contains a regular grid of pixels, each pixel value being of type `T`. The image grid can have up to 4 dimensions : width, height, depth and number of channels. Usually, the three first dimensions are used to describe spatial coordinates `(x,y,z)`, while the number of channels is rather used as a vector-valued dimension (it may describe the R,G,B color channels for instance). If you need a fifth dimension, you can use image lists **CImgList** (p. 145)<T> rather than simple images **CImg** (p. 25)<T>.

Thus, the **CImg** (p. 25)<T> class is able to represent volumetric images of vector-valued pixels, as well as images with less dimensions (1D scalar signal, 2D color images, ...). Most member functions of the class **CImg** (p. 25)<T> are designed to handle this maximum case of (3+1) dimensions.

Concerning the pixel value type `T` : fully supported template types are the basic C++ types : `unsigned char, char, short, unsigned int, int, unsigned long, long, float, double, ...` . Typically, fast image display can be done using `CImg<unsigned`

char> images, while complex image processing algorithms may be rather coded using CImg<float> or CImg<double> images that have floating-point pixel values. The default value for the template T is float. Using your own template types may be possible. However, you will certainly have to define the complete set of arithmetic and logical operators for your class.

Image structure

The **CImg** (p. 25)<T> structure contains *five* fields :

- **width** (p. 134) defines the number of *columns* of the image (size along the X-axis).
- **height** (p. 134) defines the number of *rows* of the image (size along the Y-axis).
- **depth** (p. 135) defines the number of *slices* of the image (size along the Z-axis).
- **dim** (p. 135) defines the number of *channels* of the image (size along the V-axis).
- **data** (p. 85) defines a *pointer* to the *pixel data* (of type T).

You can access these fields publicly although it is recommended to use the dedicated functions **dimx()** (p. 94), **dimy()** (p. 94), **dimz()** (p. 94), **dimv()** (p. 95) and ptr() to do so. Image dimensions are not limited to a specific range (as long as you got enough available memory). A value of *1* usually means that the corresponding dimension is *flat*. If one of the dimensions is *0*, or if the data pointer is null, the image is considered as *empty*. Empty images should not contain any pixel data and thus, will not be processed by **CImg** (p. 25) member functions (a CImgInstanceException will be thrown instead). Pixel data are stored in memory, in a non interlaced mode (See **How pixel data are stored with CImg.** (p. 17)).

Image declaration and construction

Declaring an image can be done by using one of the several available constructors. Here is a list of the most used :

- Construct images from arbitrary dimensions :
  - CImg<char> img; declares an empty image.
  - CImg<unsigned char> img(128,128); declares a 128x128 greyscale image with unsigned char pixel values.
  - CImg<double> img(3,3); declares a 3x3 matrix with double coefficients.
  - CImg<unsigned char> img(256,256,1,3); declares a 256x256x1x3 (color) image (colors are stored as an image with three channels).
  - CImg<double> img(128,128,128); declares a 128x128x128 volumetric and greyscale image (with double pixel values).
  - CImg<> img(128,128,128,3); declares a 128x128x128 volumetric color image (with float pixels, which is the default value of the template parameter T).
  - **Note** : images pixels are **not automatically initialized to 0**. You may use the function **fill()** (p. 40) to do it, or use the specific constructor taking 5 parameters like this : CImg<> img(128,128,128,3,0); declares a 128x128x128 volumetric color image with all pixel values to 0.

- Construct images from filenames :
  - `CImg<unsigned char> img("image.jpg");` reads a JPEG color image from the file "image.jpg".
  - `CImg<float> img("analyze.hdr");` reads a volumetric image (ANALYZE7.5 format) from the file "analyze.hdr".
  - **Note** : You need to install `ImageMagick` to be able to read common compressed image formats (JPG,PNG, ...) (See **Files IO in CImg.** (p. 17)).

- Construct images from C-style arrays :
  - `CImg<int> img(data_buffer,256,256);` constructs a 256x256 greyscale image from a `int*` buffer `data_buffer` (of size 256x256=65536).
  - `CImg<unsigned char> img(data_buffer,256,256,1,3,false);` constructs a 256x256 color image from a `unsigned char*` buffer `data_buffer` (where R,G,B channels follow each others).
  - `CImg<unsigned char> img(data_buffer,256,256,1,3,true);` constructs a 256x256 color image from a `unsigned char*` buffer `data_buffer` (where R,G,B channels are multiplexed).

The complete list of constructors can be found `here`.

Most useful functions

The **CImg** (p. 25)<T> class contains a lot of functions that operates on images. Some of the most useful are :

- **operator()()** (p. 96), **operator[ ]()** (p. 96) : allows to access or write pixel values.
- **display()** (p. 76) : displays the image in a new window.

See also:

CImgList (p. 145), **CImgDisplay** (p. 135), **CImgException** (p. 143).

4.1.2 Member Typedef Documentation

4.1.2.1 typedef T* iterator

Iterator type for CImg<T>.

Remarks:

- An `iterator` is a `T*` pointer (address of a pixel value in the pixel buffer).
- Iterators are not directly used in CImg functions, they have been introduced for compatibility with the STL.

4.1.2.2 typedef const T* const_iterator

Const iterator type for CImg<T>.

Remarks:

- A `const_iterator` is a `const T*` pointer (address of a pixel value in the pixel buffer).
- Iterators are not directly used in CImg functions, they have been introduced for compatibility with the STL.

4.1.3 Constructor & Destructor Documentation

4.1.3.1 CImg ()

Default constructor.

The default constructor creates an empty instance image.

Remarks:

- An empty image does not contain any data and has all of its dimensions **width** (p. 134), **height** (p. 134), **depth** (p. 135), **dim** (p. 135) set to 0 as well as its pointer to the pixel buffer **data** (p. 85).
- An empty image is non-shared.

See also:

~**CImg()** (p. 88), **assign()** (p. 91), **is_empty()** (p. 30).

4.1.3.2 ~CImg ()

Destructor.

The destructor destroys the instance image.

Remarks:

- Destructing an empty or shared image does nothing.
- Otherwise, all memory used to store the pixel data of the instance image is freed.
- When destroying a non-shared image, be sure that every shared instances of the same image are also destroyed to avoid further access to desallocated memory buffers.

See also:

CImg() (p. 88), **assign()** (p. 91), **is_empty()** (p. 30).

4.1.3.3 CImg (const unsigned int *dx*, const unsigned int *dy* = 1, const unsigned int *dz* = 1, const unsigned int *dv* = 1) [explicit]

Constructs a new image with given size (`dx`,`dy`,`dz`,`dv`).

This constructors create an instance image of size (`dx`,`dy`,`dz`,`dv`) with pixels of type `T`.

Parameters:

dx Desired size along the X-axis, i.e. the **width** (p. 134) of the image.

dy Desired size along the Y-axis, i.e. the **height** (p. 134) of the image.

dz Desired size along the Z-axis, i.e. the **depth** (p. 135) of the image.

dv Desired size along the V-axis, i.e. the number of image channels **dim** (p. 135).

Remarks:

- If one of the input dimension `dx`,`dy`,`dz` or `dv` is set to 0, the created image is empty and all has its dimensions set to 0. No memory for pixel data is then allocated.
- This constructor creates only non-shared images.
- Image pixels allocated by this constructor are **not initialized**. Use the constructor **CImg(const unsigned int,const unsigned int,const unsigned int,const unsigned int,const T)** (p. 89) to get an image of desired size with pixels set to a particular value.

See also:

assign(const unsigned int,const unsigned int,const unsigned int,const unsigned int) (p. 91), **CImg(const unsigned int,const unsigned int,const unsigned int,const unsigned int,const T)** (p. 89).

4.1.3.4 CImg (const unsigned int *dx*, const unsigned int *dy*, const unsigned int *dz*, const unsigned int *dv*, const T *val*)

Construct an image with given size (`dx`,`dy`,`dz`,`dv`) and with pixel having a default value `val`.

This constructor creates an instance image of size (`dx`,`dy`,`dz`,`dv`) with pixels of type `T` and sets all pixel values of the created instance image to `val`.

Parameters:

dx Desired size along the X-axis, i.e. the **width** (p. 134) of the image.

dy Desired size along the Y-axis, i.e. the **height** (p. 134) of the image.

dz Desired size along the Z-axis, i.e. the **depth** (p. 135) of the image.

dv Desired size along the V-axis, i.e. the number of image channels `dim`.

val Default value for image pixels.

Remarks:

- This constructor has the same properties as **CImg(const unsigned int,const unsigned int,const unsigned int,const unsigned int)** (p. 88).

See also:

CImg(const unsigned int,const unsigned int,const unsigned int,const unsigned int) (p. 88).

4.1.3.5 CImg (const t *const *data_buffer*, const unsigned int *dx*, const unsigned int *dy* = `1`, const unsigned int *dz* = `1`, const unsigned int *dv* = `1`, const bool *shared* = `false`)

Construct an image from a raw memory buffer.

This constructor creates an instance image of size (`dx`,`dy`,`dz`,`dv`) and fill its pixel buffer by copying data values from the input raw pixel buffer `data_buffer`.

4.1.3.6 CImg (const CImg< t > & *img*)

Default copy constructor.

The default copy constructor creates a new instance image having same dimensions (**width** (p. 134), **height** (p. 134), **depth** (p. 135), **dim** (p. 135)) and same pixel values as the input image `img`.

Parameters:

img The input image to copy.

Remarks:

- If the input image `img` is non-shared or have a different template type `t != T`, the default copy constructor allocates a new pixel buffer and copy the pixel data of `img` into it. In this case, the pointers **data** (p. 85) to the pixel buffers of the two images are different and the resulting instance image is non-shared.
- If the input image `img` is shared and has the same template type `t == T`, the default copy constructor does not allocate a new pixel buffer and the resulting instance image shares its pixel buffer with the input image `img`, which means that modifying pixels of `img` also modifies the created instance image.
- Copying an image having a different template type `t != T` performs a crude static cast conversion of each pixel value from type `t` to type `T`.
- Copying an image having the same template type `t == T` is significantly faster.

See also:

assign(const CImg< t >&) (p. 92), **CImg(const CImg< t >&, const bool)** (p. 90).

4.1.3.7 CImg (const CImg< t > & *img*, const bool *shared*)

Advanced copy constructor.

The advanced copy constructor - as the default constructor **CImg(const CImg< t >&)** (p. 90) - creates a new instance image having same dimensions **width** (p. 134), **height** (p. 134), **depth** (p. 135), **dim** (p. 135) and same pixel values as the input image `img`. But it also decides if the created instance image shares its memory with the input image `img` (if the input parameter `shared` is set to `true`) or not (if the input parameter `shared` is set to `false`).

Parameters:

img The input image to copy.

shared Boolean flag that decides if the copy is shared on non-shared.

Remarks:

- It is not possible to create a shared copy if the input image `img` is empty or has a different pixel type `t != T`.
- If a non-shared copy of the input image `img` is created, a new memory buffer is allocated for pixel data.
- If a shared copy of the input image `img` is created, no extra memory is allocated and the pixel buffer of the instance image is the same as the one used by the input image `img`.

See also:

CImg(const CImg<t>&) (p. 90), **assign(const CImg<t>&, const bool)** (p. 93).

4.1.3.8 CImg (const char *const *filename*)

Construct an image from an image file.

This constructor creates an instance image by reading it from a file.

Parameters:

filename Filename of the image file.

Remarks:

- The image format is deduced from the filename only by looking for the filename extension i.e. without analyzing the file itself.
- Recognized image formats depend on the tools installed on your system or the external libraries you use to link your code with. More informations on this topic can be found in cimg_files_io.
- If the filename is not found, a CImgIOException is thrown by this constructor.

See also:

assign(const char *const) (p. 93), load(const char *const)

4.1.4 Member Function Documentation

4.1.4.1 CImg<T>& assign ()

In-place version of the default constructor.

This function replaces the instance image by an empty image.

Remarks:

- Memory used by the previous content of the instance image is freed if necessary.
- If the instance image was initially shared, it is replaced by a (non-shared) empty image.
- This function is useful to free memory used by an image that is not of use, but which has been created in the current code scope (i.e. not destroyed yet).

See also:

~CImg() (p. 88), **assign()** (p. 91), **is_empty()** (p. 30).

4.1.4.2 CImg<T>& clear ()

In-place version of the default constructor.

This function is strictly equivalent to **assign()** (p. 91) and has been introduced for having a STL-compliant function name.

See also:

assign() (p. 91).

4.1.4.3 CImg<T>& assign (const unsigned int *dx*, const unsigned int *dy* = 1, const unsigned int *dz* = 1, const unsigned int *dv* = 1)

In-place version of the previous constructor.

This function replaces the instance image by a new image of size (dx,dy,dz,dv) with pixels of type T.

Parameters:

dx Desired size along the X-axis, i.e. the **width** (p. 134) of the image.

dy Desired size along the Y-axis, i.e. the **height** (p. 134) of the image.

dz Desired size along the Z-axis, i.e. the **depth** (p. 135) of the image.

dv Desired size along the V-axis, i.e. the number of image channels `dim`.

- If one of the input dimension `dx`,`dy`,`dz` or `dv` is set to 0, the instance image becomes empty and all has its dimensions set to 0. No memory for pixel data is then allocated.
- Memory buffer used to store previous pixel values is freed if necessary.
- If the instance image is shared, this constructor actually does nothing more than verifying that new and old image dimensions fit.
- Image pixels allocated by this function are **not initialized**. Use the function **assign(const unsigned int,const unsigned int,const unsigned int,const unsigned int,const T)** (p. 92) to assign an image of desired size with pixels set to a particular value.

See also:

CImg() (p. 88), **assign(const unsigned int,const unsigned int,const unsigned int,const unsigned int)** (p. 91).

4.1.4.4 CImg<T>& assign (const unsigned int *dx*, const unsigned int *dy*, const unsigned int *dz*, const unsigned int *dv*, const T *val*)

In-place version of the previous constructor.

This function replaces the instance image by a new image of size (`dx`,`dy`,`dz`,`dv`) with pixels of type `T` and sets all pixel values of the instance image to `val`.

Parameters:

dx Desired size along the X-axis, i.e. the **width** (p. 134) of the image.

dy Desired size along the Y-axis, i.e. the **height** (p. 134) of the image.

dz Desired size along the Z-axis, i.e. the **depth** (p. 135) of the image.

dv Desired size along the V-axis, i.e. the number of image channels `dim`.

val Default value for image pixels.

Remarks:

- This function has the same properties as **assign(const unsigned int,const unsigned int,const unsigned int,const unsigned int)** (p. 91).

See also:

assign(const unsigned int,const unsigned int,const unsigned int,const unsigned int) (p. 91).

4.1.4.5 CImg<T>& assign (const CImg< t > & *img*)

In-place version of the default copy constructor.

This function assigns a copy of the input image `img` to the current instance image.

Parameters:

img The input image to copy.

Remarks:

- If the instance image is not shared, the content of the input image `img` is copied into a new buffer becoming the new pixel buffer of the instance image, while the old pixel buffer is freed if necessary.
- If the instance image is shared, the content of the input image `img` is copied into the current (shared) pixel buffer of the instance image, modifying then the image referenced by the shared instance image. The instance image still remains shared.

See also:

CImg(const CImg< t >&) (p. 90), **operator=(const CImg< t >&)** (p. 100).

4.1.4.6 CImg<T>& assign (const CImg< t > & *img*, const bool *shared*)

In-place version of the advanced constructor.

This function - as the simpler function **assign(const CImg< t >&)** (p. 92) - assigns a copy of the input image `img` to the current instance image. But it also decides if the copy is shared (if the input parameter `shared` is set to `true`) or non-shared (if the input parameter `shared` is set to `false`).

Parameters:

img The input image to copy.

shared Boolean flag that decides if the copy is shared or non-shared.

Remarks:

- It is not possible to assign a shared copy if the input image `img` is empty or has a different pixel type `t` != `T`.
- If a non-shared copy of the input image `img` is assigned, a new memory buffer is allocated for pixel data.
- If a shared copy of the input image `img` is assigned, no extra memory is allocated and the pixel buffer of the instance image is the same as the one used by the input image `img`.

See also:

CImg(const CImg<t>&, const bool) (p. 90), **assign(const CImg< t >&)** (p. 92).

4.1.4.7 CImg<T>& assign (const char *const *filename*)

In-place version of the previous constructor.

This function replaces the instance image by the one that have been read from the given file.

Parameters:

filename Filename of the image file.

- The image format is deduced from the filename only by looking for the filename extension i.e. without analyzing the file itself.
- Recognized image formats depend on the tools installed on your system or the external libraries you use to link your code with. More informations on this topic can be found in cimg_files_io.
- If the filename is not found, a CImgIOException is thrown by this constructor.

4.1.4.8 static const char* pixel_type () [static]

Return the type of the pixel values.

Returns:

a string describing the type of the image pixels (template parameter `T`).

- The string returned may contains spaces (`"unsigned char"`).
- If the template parameter T does not correspond to a registered type, the string `"unknown"` is returned.

4.1.4.9 unsigned long size () const

Return the total number of pixel values in an image.

- Equivalent to : **dimx()** (p. 94) * **dimy()** (p. 94) * **dimz()** (p. 94) * **dimv()** (p. 95).

example:

```
CImg<> img(100,100,1,3);
if (img.size()==100*100*3) std::fprintf(stderr,"This statement is true");
```

See also:

dimx() (p. 94), **dimy()** (p. 94), **dimz()** (p. 94), **dimv()** (p. 95)

4.1.4.10 int dimx () const

Return the number of columns of the instance image (size along the X-axis, i.e image width).

See also:

width (p. 134), **dimy()** (p. 94), **dimz()** (p. 94), **dimv()** (p. 95), **size()** (p. 94).

4.1.4.11 int dimy () const

Return the number of rows of the instance image (size along the Y-axis, i.e image height).

See also:

height (p. 134), **dimx()** (p. 94), **dimz()** (p. 94), **dimv()** (p. 95), **size()** (p. 94).

4.1.4.12 int dimz () const

Return the number of slices of the instance image (size along the Z-axis).

See also:

depth (p. 135), **dimx()** (p. 94), **dimy()** (p. 94), **dimv()** (p. 95), **size()** (p. 94).

4.1.4.13 int dimv () const

Return the number of vector channels of the instance image (size along the V-axis).

See also:

dim (p. 135), **dimx()** (p. 94), **dimy()** (p. 94), **dimz()** (p. 94), **size()** (p. 94).

4.1.4.14 bool is_overlapping (const CImg< t > & *img*) const

Return `true` if the memory buffers of the two images overlaps.

May happen when using shared images.

4.1.4.15 long offset (const int *x*, const int *y*, const int *z*, const int *v*) const

Return the offset of the pixel coordinates (x,y,z,v) with respect to the data pointer `data`.

Parameters:

- ***x*** X-coordinate of the pixel.
- ***y*** Y-coordinate of the pixel.
- ***z*** Z-coordinate of the pixel.
- ***v*** V-coordinate of the pixel.

- No checking is done on the validity of the given coordinates.

Example:

```
CImg<float> img(100,100,1,3,0);         // Define a 100x100 color image with float-valued black
long off = img.offset(10,10,0,2);       // Get the offset of the blue value of the pixel locate
float val = img[off];                   // Get the blue value of the pixel.
```

See also:

ptr(), **operator()()** (p. 96), **operator[ ]()** (p. 96), **How pixel data are stored with CImg.** (p. 17).

4.1.4.16 T* ptr (const unsigned int *x*, const unsigned int *y*, const unsigned int *z*, const unsigned int *v*)

Return a pointer to the pixel value located at (x,y,z,v).

Parameters:

- ***x*** X-coordinate of the pixel.
- ***y*** Y-coordinate of the pixel.
- ***z*** Z-coordinate of the pixel.
- ***v*** V-coordinate of the pixel.

- When called without parameters, ptr() returns a pointer to the begining of the pixel buffer.
- If the macro `cimg_debug` == 3, boundary checking is performed and warning messages may appear if given coordinates are outside the image range (but function performances decrease).

example:

```
CImg<float> img(100,100,1,1,0);   // Define a 100x100 greyscale image with float-valued pixels.
float *ptr = ptr(10,10);          // Get a pointer to the pixel located at (10,10).
float val = *ptr;                 // Get the pixel value.
```

See also:

data (p. 85), **offset()** (p. 95), **operator()()** (p. 96), **operator[ ]()** (p. 96), **How pixel data are stored with CImg.** (p. 17), **Setting Environment Variables** (p. 7).

4.1.4.17 T& operator() (const unsigned int *x*, const unsigned int *y*, const unsigned int *z*, const unsigned int *v*)

Fast access to pixel value for reading or writing.

Parameters:

x X-coordinate of the pixel.

y Y-coordinate of the pixel.

z Z-coordinate of the pixel.

v V-coordinate of the pixel.

- If one image dimension is equal to 1, it can be omitted in the coordinate list (see example below).
- If the macro `cimg_debug` == 3, boundary checking is performed and warning messages may appear (but function performances decrease).

example:

```
CImg<float> img(100,100,1,3,0);                     // Define a 100x100 color image with floa
const float valR = img(10,10,0,0);                  // Read the red component at coordinates
const float valG = img(10,10,0,1);                  // Read the green component at coordinate
const float valB = img(10,10,2);                    // Read the blue component at coordinates
const float avg = (valR + valG + valB)/3;           // Compute average pixel value.
img(10,10,0) = img(10,10,1) = img(10,10,2) = avg;   // Replace the pixel (10,10) by the avera
```

See also:

operator[ ]() (p. 96), ptr(), **offset()** (p. 95), **How pixel data are stored with CImg.** (p. 17), **Setting Environment Variables** (p. 7).

4.1.4.18 T& operator[ ] (const unsigned long *off*)

Fast access to pixel value for reading or writing, using an offset to the image pixel.

Parameters:

off Offset of the pixel according to the begining of the pixel buffer, given by ptr().

- If the macro `cimg_debug==3`, boundary checking is performed and warning messages may appear (but function performances decrease).
- As pixel values are aligned in memory, this operator can sometime useful to access values easier than with **operator()()** (p. 96) (see example below).

example:

```
CImg<float> vec(1,10);        // Define a vector of float values (10 lines, 1 row).
const float val1 = vec(0,4);  // Get the fifth element using operator()().
const float val2 = vec[4];    // Get the fifth element using operator[]. Here, val2==val1.
```

See also:

operator()() (p. 96), ptr(), **offset()** (p. 95), **How pixel data are stored with CImg.** (p. 17), **Setting Environment Variables** (p. 7).

4.1.4.19 T pix1d (const int *x*, const int *y*, const int *z*, const int *v*, const T *out_val*) const

Read a pixel value with Dirichlet or Neumann boundary conditions.

Parameters:

x X-coordinate of the pixel.

y Y-coordinate of the pixel.

z Z-coordinate of the pixel.

v V-coordinate of the pixel.

out_val Desired value if pixel coordinates are outside the image range (optional parameter).

- This function allows to read pixel values with boundary checking on all coordinates.
- If given coordinates are outside the image range and the parameter out_val is specified, the value `out_val` is returned.
- If given coordinates are outside the image range and the parameter out_val is not specified, the closest pixel value is returned.

example:

```
CImg<float> img(100,100,1,1,128);           // Define a 100x100 images with all pixel values eq
const float val1 = img.pix4d(10,10,0,0,0);  // Equivalent to val1=img(10,10) (but slower).
const float val2 = img.pix4d(-4,5,0,0,0);   // Return 0, since coordinates are outside the imag
const float val3 = img.pix4d(10,10,5,0,64); // Return 64, since coordinates are outside the ima
```

See also:

operator()() (p. 96), **linear_pix4d()** (p. 98), **cubic_pix2d()** (p. 99).

4.1.4.20 cimg::superset<T,float>::type linear_pix1d (const float *fx*, const int *y*, const int *z*, const int *v*, const T *out_val*) const

Read a pixel value using linear interpolation for the first coordinate `cx`.

- Same as **linear_pix4d()** (p. 98), except that linear interpolation and boundary checking is performed only on the first coordinate.

See also:

operator()() (p. 96), **linear_pix4d()** (p. 98), **linear_pix3d()** (p. 98), **linear_pix2d()** (p. 98), **linear_pix1d()** (p. 97), **cubic_pix1d()** (p. 99).

4.1.4.21 cimg::superset<T,float>::type linear_pix2d (const float *fx*, const float *fy*, const int *z*, const int *v*, const T *out_val*) const

Read a pixel value using linear interpolation for the two first coordinates (cx,cy).

- Same as **linear_pix4d()** (p. 98), except that linear interpolation and boundary checking is performed only on the two first coordinates.

See also:

operator()() (p. 96), **linear_pix4d()** (p. 98), **linear_pix3d()** (p. 98), **linear_pix1d()** (p. 97), **linear_pix2d()** (p. 98), **cubic_pix2d()** (p. 99).

4.1.4.22 cimg::superset<T,float>::type linear_pix3d (const float *fx*, const float *fy*, const float *fz*, const int *v*, const T *out_val*) const

Read a pixel value using linear interpolation for the three first coordinates (cx,cy,cz).

- Same as **linear_pix4d()** (p. 98), except that linear interpolation and boundary checking is performed only on the three first coordinates.

See also:

operator()() (p. 96), **linear_pix4d()** (p. 98), **linear_pix2d()** (p. 98), **linear_pix1d()** (p. 97), **linear_pix3d()** (p. 98), **cubic_pix2d()** (p. 99).

4.1.4.23 cimg::superset<T,float>::type linear_pix4d (const float *fx*, const float *fy*, const float *fz*, const float *fv*, const T *out_val*) const

Read a pixel value using linear interpolation.

Parameters:

fx X-coordinate of the pixel (float-valued).

fy Y-coordinate of the pixel (float-valued).

fz Z-coordinate of the pixel (float-valued).

fv V-coordinate of the pixel (float-valued).

out_val Out-of-border pixel value

- This function allows to read pixel values with boundary checking on all coordinates.
- If given coordinates are outside the image range, the value of the nearest pixel inside the image is returned (Neumann boundary conditions).
- If given coordinates are float-valued, a linear interpolation is performed in order to compute the returned value.

example:

```
CImg<float> img(2,2);     // Define a greyscale 2x2 image.
img(0,0) = 0;             // Fill image with specified pixel values.
img(1,0) = 1;
img(0,1) = 2;
img(1,1) = 3;
const double val = img.linear_pix4d(0.5,0.5);  // Return val=1.5, which is the average intensit
```

See also:

operator()() (p. 96), **linear_pix3d()** (p. 98), **linear_pix2d()** (p. 98), **linear_pix1d()** (p. 97), **cubic_pix2d()** (p. 99).

4.1.4.24 cimg::superset<T,float>::type cubic_pix1d (const float *fx*, const int *y*, const int *z*, const int *v*, const T *out_val*) const

Read a pixel value using cubic interpolation for the first coordinate `cx`.

- Same as **cubic_pix2d()** (p. 99), except that cubic interpolation and boundary checking is performed only on the first coordinate.

See also:

operator()() (p. 96), **cubic_pix2d()** (p. 99), **linear_pix1d()** (p. 97).

4.1.4.25 cimg::superset<T,float>::type cubic_pix2d (const float *fx*, const float *fy*, const int *z*, const int *v*, const T *out_val*) const

Read a pixel value using bicubic interpolation.

Parameters:

fx X-coordinate of the pixel (float-valued).

fy Y-coordinate of the pixel (float-valued).

z Z-coordinate of the pixel.

v V-coordinate of the pixel.

out_val Value considered at image borders.

- This function allows to read pixel values with boundary checking on the two first coordinates.
- If given coordinates are outside the image range, the value of the nearest pixel inside the image is returned (Neumann boundary conditions).
- If given coordinates are float-valued, a cubic interpolation is performed in order to compute the returned value.

See also:

operator()() (p. 96), **cubic_pix1d()** (p. 99), **linear_pix2d()** (p. 98).

4.1.4.26 const CImg<T>& print (const char * *title* = `0`, const int *print_flag* = `1`) const

Display informations about the image on the standard error output.

Parameters:

title Name for the considered image (optional).

print_flag Level of informations to be printed.

- The possible values for `print_flag` are :

- -1 : print nothing
- 0 : print only informations about image size and pixel buffer.
- 1 : print also statistics on the image pixels.
- 2 : print also the content of the pixel buffer, in a matlab-style.

example:

```
CImg<float> img("foo.jpg");      // Load image from a JPEG file.
img.print("Image : foo.jpg",1);  // Print image informations and statistics.
```

4.1.4.27 CImg<T>& operator= (const CImg< t > & *img*)

Assignment operator.

This operator assigns a copy of the input image `img` to the current instance image.

Parameters:

img The input image to copy.

Remarks:

- This operator is strictly equivalent to the function **assign(const CImg< t >&)** (p. 92) and has exactly the same properties.

See also:

assign(const CImg< t >&) (p. 92).

4.1.4.28 CImg<T>& operator= (const T * *buf*)

Assign values of a C-array to the instance image.

Parameters:

buf Pointer to a C-style array having a size of (at least) `this->`**`size()`** (p. 94).

- Replace pixel values by the content of the array `buf`.
- Warning : the value types in the array and in the image must be the same.

example:

```
float tab[4*4] = { 1,2,3,4, 5,6,7,8, 9,10,11,12, 13,14,15,16 };  // Define a 4x4 matrix in C-st
CImg<float> matrice(4,4);                                        // Define a 4x4 greyscale imag
matrice = tab;                                                   // Fill the image by the value
```

4.1.4.29 CImg<T> operator+ () const

Operator+.

Remarks:

- This operator can be used to get a non-shared copy of an image.

4.1.4.30 CImg<T> get_round (const float *x*, const unsigned int *round_type* = 0) const

Compute image with rounded pixel values.

Parameters:

x Rounding precision.

round_type Roundin type, can be 0 (nearest), 1 (forward), 2 (backward).

4.1.4.31 CImg<T> get_fill (const T *val*) const

Fill an image by a value `val`.

Parameters:

val = fill value

Note:

All pixel values of the instance image will be initialized by `val`.

See also:

operator=() (p. 100).

4.1.4.32 CImg<T> get_normalize (const T *a*, const T *b*) const

Linear normalization of the pixel values between *a* and *b*.

Parameters:

a = minimum pixel value after normalization.

b = maximum pixel value after normalization.

4.1.4.33 CImg<T> get_cut (const T *a*, const T *b*) const

Cut pixel values between *a* and *b*.

Parameters:

a = minimum pixel value after cut.

b = maximum pixel value after cut.

4.1.4.34 CImg<T> get_quantize (const unsigned int *n* = 256, const bool *keep_range* = true) const

Quantize pixel values into

levels.

Parameters:

n = number of quantification levels

keep_range = keep same value range.

4.1.4.35 CImg<T> get_threshold (const T *thres*) const

Threshold the image.

Parameters:

thres = threshold

4.1.4.36 CImg<T> get_rotate (const float *angle*, const unsigned int *cond* = 3) const

Return a rotated image.

Parameters:

angle = rotation angle (in degrees).

cond = rotation type. can be :

- 0 = zero-value at borders
- 1 = repeat image at borders
- 2 = zero-value at borders and linear interpolation

Note:

Returned image will probably have a different size than the instance image ∗this.

4.1.4.37 CImg<T> get_rotate (const float *angle*, const float *cx*, const float *cy*, const float *zoom* = 1, const unsigned int *cond* = 3) const

Return a rotated image around the point (cx,cy).

Parameters:

angle = rotation angle (in degrees).

cx = X-coordinate of the rotation center.

cy = Y-coordinate of the rotation center.

zoom = zoom.

cond = rotation type. can be :

- 0 = zero-value at borders
- 1 = repeat image at borders
- 2 = zero-value at borders and linear interpolation

See also:

rotate() (p. 44)

4.1.4.38 CImg<T> get_resize (const int *pdx* = −100, const int *pdy* = −100, const int *pdz* = −100, const int *pdv* = −100, const int *interp* = 1, const int *border_condition* = −1, const bool *center* = false) const

Return a resized image.

Parameters:

pdx Number of columns (new size along the X-axis).

pdy Number of rows (new size along the Y-axis).

pdz Number of slices (new size along the Z-axis).

pdv Number of vector-channels (new size along the V-axis).

interp Method of interpolation :

- -1 = no interpolation : raw memory resizing.
- 0 = no interpolation : additional space is filled according to `border_condition`.
- 1 = bloc interpolation (nearest point).
- 2 = moving average interpolation.
- 3 = linear interpolation.
- 4 = grid interpolation.
- 5 = bi-cubic interpolation.

border_condition Border condition type.

center Set centering type (only if `interp=0`).

Note:

If pd[x,y,z,v]<0, it corresponds to a percentage of the original size (the default value is -100).

4.1.4.39 CImg<T> get_resize (const CImg< t > & *src*, const int *interp* = `1`, const int *border_condition* = `-1`, const bool *center* = `false`) const

Return a resized image.

Parameters:

src Image giving the geometry of the resize.

interp Interpolation method :

- 1 = raw memory
- 0 = no interpolation : additional space is filled with 0.
- 1 = bloc interpolation (nearest point).
- 2 = mosaic : image is repeated if necessary.
- 3 = linear interpolation.
- 4 = grid interpolation.
- 5 = bi-cubic interpolation.

border_condition Border condition type.

Note:

If pd[x,y,z,v]<0, it corresponds to a percentage of the original size (the default value is -100).

4.1.4.40 CImg<T> get_resize (const CImgDisplay & *disp*, const int *interp* = `1`, const int *border_condition* = `-1`, const bool *center* = `false`) const

Return a resized image.

Parameters:

disp = Display giving the geometry of the resize.

interp = Resizing type :

- 0 = no interpolation : additional space is filled with 0.
- 1 = bloc interpolation (nearest point).
- 2 = mosaic : image is repeated if necessary.
- 3 = linear interpolation.
- 4 = grid interpolation.
- 5 = bi-cubic interpolation.
- 6 = moving average (best quality for photographs)

border_condition Border condition type.

Note:

If pd[x,y,z,v]<0, it corresponds to a percentage of the original size (the default value is -100).

4.1.4.41 CImg<T> get_permute_axes (const char * *permut* = "vxyz") const

Permute axes order.

This function permutes image axes.

Parameters:

permut = String describing the permutation (4 characters).

4.1.4.42 CImg<T> get_translate (const int *deltax*, const int *deltay* = 0, const int *deltaz* = 0, const int *deltav* = 0, const int *border_condition* = 0) const

Translate the image.

Parameters:

deltax Amount of displacement along the X-axis.

deltay Amount of displacement along the Y-axis.

deltaz Amount of displacement along the Z-axis.

deltav Amount of displacement along the V-axis.

border_condition Border condition.

- `border_condition` can be :
  - 0 : Zero border condition (Dirichlet).
  - 1 : Nearest neighbors (Neumann).
  - 2 : Repeat Pattern (Fourier style).

4.1.4.43 CImg<T> get_crop (const int *x0*, const int *y0*, const int *z0*, const int *v0*, const int *x1*, const int *y1*, const int *z1*, const int *v1*, const bool *border_condition* = `false`) const

Return a square region of the image, as a new image.

Parameters:

x0 = X-coordinate of the upper-left crop rectangle corner.

y0 = Y-coordinate of the upper-left crop rectangle corner.

z0 = Z-coordinate of the upper-left crop rectangle corner.

v0 = V-coordinate of the upper-left crop rectangle corner.

x1 = X-coordinate of the lower-right crop rectangle corner.

y1 = Y-coordinate of the lower-right crop rectangle corner.

z1 = Z-coordinate of the lower-right crop rectangle corner.

v1 = V-coordinate of the lower-right crop rectangle corner.

border_condition = Dirichlet (false) or Neumann border conditions.

4.1.4.44 CImg<T> get_crop (const int *x0*, const int *y0*, const int *z0*, const int *x1*, const int *y1*, const int *z1*, const bool *border_condition* = `false`) const

Return a square region of the image, as a new image.

Parameters:

x0 = X-coordinate of the upper-left crop rectangle corner.

y0 = Y-coordinate of the upper-left crop rectangle corner.

z0 = Z-coordinate of the upper-left crop rectangle corner.

x1 = X-coordinate of the lower-right crop rectangle corner.

y1 = Y-coordinate of the lower-right crop rectangle corner.

z1 = Z-coordinate of the lower-right crop rectangle corner.

border_condition = determine the type of border condition if some of the desired region is outside the image.

4.1.4.45 CImg<T> get_crop (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const bool *border_condition* = `false`) const

Return a square region of the image, as a new image.

Parameters:

x0 = X-coordinate of the upper-left crop rectangle corner.

y0 = Y-coordinate of the upper-left crop rectangle corner.

x1 = X-coordinate of the lower-right crop rectangle corner.

y1 = Y-coordinate of the lower-right crop rectangle corner.

border_condition = determine the type of border condition if some of the desired region is outside the image.

4.1.4.46 CImg<T> get_crop (const int *x0*, const int *x1*, const bool *border_condition* = false) const

Return a square region of the image, as a new image.

Parameters:

x0 = X-coordinate of the upper-left crop rectangle corner.

x1 = X-coordinate of the lower-right crop rectangle corner.

border_condition = determine the type of border condition if some of the desired region is outside the image.

4.1.4.47 CImg<typename cimg::last<T,float>::type> get_histogram (const unsigned int *nblevels* = 256, const T *val_min* = (T)0, const T *val_max* = (T)0) const

Return the image histogram.

The histogram H of an image I is a 1D-function where H(x) is the number of occurences of the value x in I.

Parameters:

nblevels = Number of different levels of the computed histogram. For classical images, this value is 256 (default value). You should specify more levels if you are working with CImg<float> or images with high range of pixel values.

val_min = Minimum value considered for the histogram computation. All pixel values lower than val_min won't be counted.

val_max = Maximum value considered for the histogram computation. All pixel values higher than val_max won't be counted.

Note:

If val_min==val_max==0 (default values), the function first estimates the minimum and maximum pixel values of the current image, then uses these values for the histogram computation.

Returns:

The histogram is returned as a 1D CImg<float> image H, having a size of (nblevels,1,1,1) such that H(0) and H(nblevels-1) are respectively equal to the number of occurences of the values val_min and val_max in I.

Note:

Histogram computation always returns a 1D function. Histogram of multi-valued (such as color) images are not multi-dimensional.

See also:

get_equalize_histogram() (p. 106), **equalize_histogram()** (p. 48)

4.1.4.48 CImg<T> get_equalize_histogram (const unsigned int *nblevels* = 256, const T *val_min* = (T)0, const T *val_max* = (T)0) const

Return the histogram-equalized version of the current image.

The histogram equalization is a classical image processing algorithm that enhances the image contrast by expanding its histogram.

Parameters:

nblevels = Number of different levels of the computed histogram. For classical images, this value is 256 (default value). You should specify more levels if you are working with CImg<float> or images with high range of pixel values.

val_min = Minimum value considered for the histogram computation. All pixel values lower than val_min won't be changed.

val_max = Maximum value considered for the histogram computation. All pixel values higher than val_max won't be changed.

Note:

If val_min==val_max==0 (default values), the function acts on all pixel values of the image.

Returns:

A new image with same size is returned, where pixels have been equalized.

See also:

get_histogram() (p. 106), **equalize_histogram()** (p. 48)

4.1.4.49 CImg<typename cimg::superset<T,float>::type> get_norm_pointwise (int *norm_type* = 2) const

Return the scalar image of vector norms.

When dealing with vector-valued images (i.e images with **dimv()** (p. 95)>1), this function computes the L1,L2 or Linf norm of each vector-valued pixel.

Parameters:

norm_type = Type of the norm being computed (1 = L1, 2 = L2, -1 = Linf).

Returns:

A scalar-valued image CImg<float> with size (**dimx()** (p. 94),**dimy()** (p. 94),**dimz()** (p. 94),1), where each pixel is the norm of the corresponding pixels in the original vector-valued image.

See also:

get_orientation_pointwise (p. 107), **orientation_pointwise** (p. 49), **norm_pointwise** (p. 49).

4.1.4.50 CImg<typename cimg::superset<T,float>::type> get_orientation_pointwise () const

Return the image of normalized vectors.

When dealing with vector-valued images (i.e images with **dimv()** (p. 95)>1), this function return the image of normalized vectors (unit vectors). Null vectors are unchanged. The L2-norm is computed for the normalization.

Returns:

A new vector-valued image with same size, where each vector-valued pixels have been normalized.

See also:

get_norm_pointwise (p. 107), **norm_pointwise** (p. 49), **orientation_pointwise** (p. 49).

4.1.4.51 CImgList<typename cimg::superset<T,float>::type> get_gradientXY (const int *scheme* = 0) const

Return a list of images, corresponding to the XY-gradients of an image.

Parameters:

scheme = Numerical scheme used for the gradient computation :

- -1 = Backward finite differences
- 0 = Centered finite differences
- 1 = Forward finite differences
- 2 = Using Sobel masks
- 3 = Using rotation invariant masks
- 4 = Using Deriche recusrsive filter.

4.1.4.52 CImgList<typename cimg::superset<T,float>::type> get_gradientXYZ (const int *scheme* = 0) const

Return a list of images, corresponding to the XYZ-gradients of an image.

See also:

get_gradientXY() (p. 108).

4.1.4.53 CImgList<typename cimg::superset<T,float>::type> get_hessianXY ()

Get components of the 2D Hessian matrix of an image.

Components are ordered as : Ixx, Ixy, Iyy

4.1.4.54 CImgList<typename cimg::superset<T,float>::type> get_hessianXYZ ()

Get components of the 3D Hessian matrix of an image.

Components are ordered as : Ixx, Ixy, Ixz, Iyy, Iyz, Izz.

4.1.4.55 static CImg<T> get_dijkstra (const tf & *distance*, const unsigned int *nb_nodes*, const unsigned int *starting_node*, const unsigned int *ending_node*, CImg< t > & *previous*) [static]

Return minimal path in a graph, using the Dijkstra algorithm.

Parameters:

distance An object having operator()(unsigned int i, unsigned int j) which returns distance between two nodes (i,j).

nb_nodes Number of graph nodes.

starting_node Indice of the starting node.

ending_node Indice of the ending node (set to ~0U to ignore ending node).

previous Array that gives the previous node indice in the path to the starting node (optional parameter).

Returns:

Array of distances of each node to the starting node.

4.1.4.56 CImg<T> get_dijkstra (const unsigned int *starting_node*, const unsigned int *ending_node*, CImg< t > & *previous*) const

Return minimal path in a graph, using the Dijkstra algorithm.

Instance image corresponds to the adjacency matrix of the graph.

Parameters:

starting_node Indice of the starting node.

previous Array that gives the previous node indice in the path to the starting node (optional parameter).

Returns:

Array of distances of each node to the starting node.

4.1.4.57 const CImg<T>& marching_squares (const float *isovalue*, const float *resx*, const float *resy*, CImgList< tp > & *points*, CImgList< tf > & *primitives*) const

Get a vectorization of an implicit function defined by the instance image.

This version allows to specify the marching squares resolution along x,y, and z.

4.1.4.58 const CImg<T>& marching_cubes (const float *isovalue*, const float *resx*, const float *resy*, const float *resz*, CImgList< tp > & *points*, CImgList< tf > & *primitives*, const bool *invert_faces* = `false`) const

Get a triangulation of an implicit function defined by the instance image.

This version allows to specify the marching cube resolution along x,y and z.

4.1.4.59 static CImg<T> get_default_LUT8 () `[static]`

Return the default 256 colors palette.

The default color palette is used by CImg when displaying images on 256 colors displays. It consists in the quantification of the (R,G,B) color space using 3:3:2 bits for color coding (i.e 8 levels for the Red and Green and 4 levels for the Blue).

Returns:

A 256x1x1x3 color image defining the palette entries.

4.1.4.60 CImg<t> get_RGBtoLUT (const CImg< t > & *palette*, const bool *dithering* = `true`, const bool *indexing* = `false`) const

Convert color pixels from (R,G,B) to match a specified palette.

This function return a (R,G,B) image where colored pixels are constrained to match entries of the specified color `palette`.

Parameters:

palette User-defined palette that will constraint the color conversion.

dithering Enable/Disable Floyd-Steinberg dithering.

indexing If `true`, each resulting image pixel is an index to the given color palette. Otherwise, (R,G,B) values of the palette are copied instead.

4.1.4.61 CImg<T> get_RGBtoLUT (const bool *dithering* = `true`, const bool *indexing* = `false`) const

Convert color pixels from (R,G,B) to match the default 256 colors palette.

Same as **get_RGBtoLUT()** (p. 109) with the default color palette given by **get_default_LUT8()** (p. 109).

4.1.4.62 CImg<T> get_RGBtoBayer () const

Convert a (R,G,B) image to a Bayer-coded representation.

Note:

First (upper-left) pixel if the red component of the pixel color.

4.1.4.63 CImg<T>& draw_point (const int *x0*, const int *y0*, const tc *const *color*, const float *opacity* = `1.0f`)

Draw a colored point (pixel) in the instance image.

Parameters:

x0 X-coordinate of the point.

y0 Y-coordinate of the point.

color Pointer to (or image of) **`dimv()`** (p. 95) consecutive values, defining the color channels.

opacity Drawing opacity (optional).

Note:

- Clipping is supported.
- To set pixel values without clipping needs, you should use the faster **CImg::operator()()** (p. 96) function.

Example:

```
CImg<unsigned char> img(100,100,1,3,0);
const unsigned char color[] = { 255,128,64 };
img.draw_point(50,50,color);
```

See also:

CImg::operator()() (p. 96).

4.1.4.64 CImg<T>& draw_point (const int *x0*, const int *y0*, const int *z0*, const tc *const *color*, const float *opacity* = `1.0f`)

Draw a colored point (pixel) in the instance image (for volumetric images).

Note:

- Similar to **CImg::draw_point()** (p. 110) for 3D volumetric images.

4.1.4.65 CImg<T>& draw_point (const CImgList< t > & *points*, const tc *const *color*, const float *opacity* = 1.0f)

Draw a cloud of colored points in the instance image.

Parameters:

points Coordinates of vertices, stored as a list of vectors.

color Pointer to **dimv()** (p. 95) consecutive values of type T, defining the drawing color.

opacity Drawing opacity (optional).

Note:

- This function uses several call to the single **CImg::draw_point()** (p. 110) procedure, depending on the vectors size in points.

Example:

```
CImg<unsigned char> img(100,100,1,3,0);
const unsigned char color[] = { 255,128,64 };
CImgList<int> points;
points.insert(CImg<int>::vector(0,0)).
      .insert(CImg<int>::vector(70,10)).
      .insert(CImg<int>::vector(80,60)).
      .insert(CImg<int>::vector(10,90));
img.draw_point(points,color);
```

See also:

CImg::draw_point() (p. 110).

4.1.4.66 CImg<T>& draw_point (const CImg< t > & *points*, const tc *const *color*, const float *opacity* = 1.0f)

Draw a cloud of points in the instance image.

Note:

- Similar to the previous function, where the N vertex coordinates are stored as a Nx2 or Nx3 image (sequence of vectors aligned along the x-axis).

4.1.4.67 CImg<T>& draw_line (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const tc *const *color*, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U, const bool *init_hatch* = true)

Draw a colored line in the instance image.

Parameters:

x0 X-coordinate of the starting line point.

y0 Y-coordinate of the starting line point.

x1 X-coordinate of the ending line point.

y1 Y-coordinate of the ending line point.

color Pointer to **dimv()** (p. 95) consecutive values of type T, defining the drawing color.

opacity Drawing opacity (optional).

pattern An integer whose bits describe the line pattern (optional).

init_hatch Flag telling if a reinitialization of the hash state must be done (optional).

Note:

- Clipping is supported.
- Line routine uses Bresenham's algorithm.
- Set `init_hatch` = false to draw consecutive hatched segments without breaking the line pattern.

Example:

```
CImg<unsigned char> img(100,100,1,3,0);
const unsigned char color[] = { 255,128,64 };
 img.draw_line(40,40,80,70,color);
```

4.1.4.68 CImg<T>& draw_line (const int *x0*, const int *y0*, const int *z0*, const int *x1*, const int *y1*, const int *z1*, const tc *const color, const float *opacity* = `1.0f`, const unsigned int *pattern* = `~0U`, const bool *init_hatch* = `true`)

Draw a colored line in the instance image (for volumetric images).

Note:

- Similar to **CImg::draw_line**() (p. 111) for 3D volumetric images.

4.1.4.69 CImg<T>& draw_line (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const CImg< t > & *texture*, const int *tx0*, const int *ty0*, const int *tx1*, const int *ty1*, const float *opacity* = `1.0f`, const unsigned int *pattern* = `~0U`, const bool *init_hatch* = `true`)

Draw a textured line in the instance image.

Parameters:

x0 X-coordinate of the starting line point.

y0 Y-coordinate of the starting line point.

x1 X-coordinate of the ending line point.

y1 Y-coordinate of the ending line point.

texture Texture image defining the pixel colors.

tx0 X-coordinate of the starting texture point.

ty0 Y-coordinate of the starting texture point.

tx1 X-coordinate of the ending texture point.

ty1 Y-coordinate of the ending texture point.

opacity Drawing opacity (optional).

pattern An integer whose bits describe the line pattern (optional).

init_hatch Flag telling if the hash variable must be reinitialized (optional).

Note:

- Clipping is supported but not for texture coordinates.

- Line routine uses the well known Bresenham's algorithm.

Example:

```
CImg<unsigned char> img(100,100,1,3,0), texture("texture256x256.ppm");
const unsigned char color[] = { 255,128,64 };
img.draw_line(40,40,80,70,texture,0,0,255,255);
```

4.1.4.70 CImg<T>& draw_line (const CImgList< t > & *points*, const tc *const *color*, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U, const bool *init_hatch* = true)

Draw a set of consecutive colored lines in the instance image.

Parameters:

points Coordinates of vertices, stored as a list of vectors.

color Pointer to **dimv()** (p. 95) consecutive values of type `T`, defining the drawing color.

opacity Drawing opacity (optional).

pattern An integer whose bits describe the line pattern (optional).

init_hatch If set to true, init hatch motif.

Note:

- This function uses several call to the single **CImg::draw_line()** (p. 111) procedure, depending on the vectors size in `points`.

Example:

```
CImg<unsigned char> img(100,100,1,3,0);
const unsigned char color[] = { 255,128,64 };
CImgList<int> points;
points.insert(CImg<int>::vector(0,0)).
      .insert(CImg<int>::vector(70,10)).
      .insert(CImg<int>::vector(80,60)).
      .insert(CImg<int>::vector(10,90));
img.draw_line(points,color);
```

See also:

CImg::draw_line() (p. 111).

4.1.4.71 CImg<T>& draw_line (const CImg< t > & *points*, const tc *const *color*, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U, const bool *init_hatch* = true)

Draw a set of consecutive colored lines in the instance image.

Note:

- Similar to the previous function, where the N vertex coordinates are stored as a Nx2 or Nx3 image (sequence of vectors aligned along the x-axis).

4.1.4.72 CImg<T>& draw_spline (const int *x0*, const int *y0*, const float *u0*, const float *v0*, const int *x1*, const int *y1*, const float *u1*, const float *v1*, const tc *const color, const float *precision* = 4.0f, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U, const bool *init_hatch* = true)

Draw a cubic spline curve in the instance image.

Parameters:

x0 X-coordinate of the starting curve point

y0 Y-coordinate of the starting curve point

u0 X-coordinate of the starting velocity

v0 Y-coordinate of the starting velocity

x1 X-coordinate of the ending curve point

y1 Y-coordinate of the ending curve point

u1 X-coordinate of the ending velocity

v1 Y-coordinate of the ending velocity

color Pointer to **dimv()** (p. 95) consecutive values of type T, defining the drawing color.

precision Curve drawing precision (optional).

opacity Drawing opacity (optional).

pattern An integer whose bits describe the line pattern (optional).

init_hatch If true, init hatch motif.

Note:

- The curve is a 2D cubic Bezier spline, from the set of specified starting/ending points and corresponding velocity vectors.
- The spline is drawn as a serie of connected segments. The precision parameter sets the average number of pixels in each drawn segment.
- A cubic Bezier curve is sometimes defined by a set of 4 points { (x0,y0), (xa,ya), (xb,yb), (x1,y1) } where (x0,y0) is the starting point, (x1,y1) is the ending point and (xa,ya), (xb,yb) are two *control* points. The starting and ending velocities (u0,v0) and (u1,v1) can be deduced easily from the control points as u0 = (xa - x0), v0 = (ya - y0), u1 = (x1 - xb) and v1 = (y1 - yb).

Example:

```
CImg<unsigned char> img(100,100,1,3,0);
const unsigned char color[] = { 255,255,255 };
img.draw_spline(30,30,0,100,90,40,0,-100,color);
```

4.1.4.73 CImg<T>& draw_spline (const int *x0*, const int *y0*, const int *z0*, const float *u0*, const float *v0*, const float *w0*, const int *x1*, const int *y1*, const int *z1*, const float *u1*, const float *v1*, const float *w1*, const tc *const color, const float *precision* = 4.0f, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U, const bool *init_hatch* = true)

Draw a cubic spline curve in the instance image (for volumetric images).

Note:

- Similar to **CImg::draw_spline()** (p. 114) for a 3D spline in a volumetric image.

4.1.4.74 CImg<T>& draw_spline (const int *x0*, const int *y0*, const float *u0*, const float *v0*, const int *x1*, const int *y1*, const float *u1*, const float *v1*, const CImg< t > & *texture*, const int *tx0*, const int *ty0*, const int *tx1*, const int *ty1*, const float *precision* = 4.0f, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U, const bool *init_hatch* = true)

Draw a cubic spline curve in the instance image.

Parameters:

x0 X-coordinate of the starting curve point

y0 Y-coordinate of the starting curve point

u0 X-coordinate of the starting velocity

v0 Y-coordinate of the starting velocity

x1 X-coordinate of the ending curve point

y1 Y-coordinate of the ending curve point

u1 X-coordinate of the ending velocity

v1 Y-coordinate of the ending velocity

texture Texture image defining line pixel colors.

tx0 X-coordinate of the starting texture point.

ty0 Y-coordinate of the starting texture point.

tx1 X-coordinate of the ending texture point.

ty1 Y-coordinate of the ending texture point.

precision Curve drawing precision (optional).

opacity Drawing opacity (optional).

pattern An integer whose bits describe the line pattern (optional).

init_hatch if true, reinit hatch motif.

4.1.4.75 CImg<T>& draw_arrow (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const tc *const *color*, const float *angle* = 30, const float *length* = -10, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U)

Draw a colored arrow in the instance image.

Parameters:

x0 X-coordinate of the starting arrow point (tail).

y0 Y-coordinate of the starting arrow point (tail).

x1 X-coordinate of the ending arrow point (head).

y1 Y-coordinate of the ending arrow point (head).

color Pointer to **dimv()** (p. 95) consecutive values of type T, defining the drawing color.

angle Aperture angle of the arrow head (optional).

length Length of the arrow head. If negative, describes a percentage of the arrow length (optional).

opacity Drawing opacity (optional).

pattern An integer whose bits describe the line pattern (optional).

Note:

- Clipping is supported.

4.1.4.76 CImg<T>& draw_image (const CImg< t > & *sprite*, const int *x0*, const int *y0* = 0, const int *z0* = 0, const int *v0* = 0, const float *opacity* = 1.0f)

Draw a sprite image in the instance image.

Parameters:

sprite Sprite image.

x0 X-coordinate of the sprite position.

y0 Y-coordinate of the sprite position.

z0 Z-coordinate of the sprite position.

v0 V-coordinate of the sprite position.

opacity Drawing opacity (optional).

Note:

- Clipping is supported.

4.1.4.77 CImg<T>& draw_image (const CImg< ti > & *sprite*, const CImg< tm > & *mask*, const int *x0*, const int *y0* = 0, const int *z0* = 0, const int *v0* = 0, const float *mask_valmax* = 1.0f, const float *opacity* = 1.0f)

Draw a sprite image in the instance image (masked version).

Parameters:

sprite Sprite image.

mask Mask image.

x0 X-coordinate of the sprite position in the instance image.

y0 Y-coordinate of the sprite position in the instance image.

z0 Z-coordinate of the sprite position in the instance image.

v0 V-coordinate of the sprite position in the instance image.

mask_valmax Maximum pixel value of the mask image `mask` (optional).

opacity Drawing opacity.

Note:

- Pixel values of `mask` set the opacity of the corresponding pixels in `sprite`.
- Clipping is supported.
- Dimensions along x,y and z of `sprite` and `mask` must be the same.

4.1.4.78 CImg<T>& draw_rectangle (const int *x0*, const int *y0*, const int *z0*, const int *v0*, const int *x1*, const int *y1*, const int *z1*, const int *v1*, const T *val*, const float *opacity* = 1.0f)

Draw a 4D filled rectangle in the instance image, at coordinates (x0,y0,z0,v0)-(x1,y1,z1,v1).

Parameters:

x0 X-coordinate of the upper-left rectangle corner.

y0 Y-coordinate of the upper-left rectangle corner.

z0 Z-coordinate of the upper-left rectangle corner.

v0 V-coordinate of the upper-left rectangle corner.

x1 X-coordinate of the lower-right rectangle corner.

y1 Y-coordinate of the lower-right rectangle corner.

z1 Z-coordinate of the lower-right rectangle corner.

v1 V-coordinate of the lower-right rectangle corner.

val Scalar value used to fill the rectangle area.

opacity Drawing opacity (optional).

Note:

- Clipping is supported.

4.1.4.79 CImg<T>& draw_rectangle (const int *x0*, const int *y0*, const int *z0*, const int *x1*, const int *y1*, const int *z1*, const tc *const *color*, const float *opacity* = 1.0f)

Draw a 3D filled colored rectangle in the instance image, at coordinates (x0,y0,z0)-(x1,y1,z1).

Parameters:

x0 X-coordinate of the upper-left rectangle corner.

y0 Y-coordinate of the upper-left rectangle corner.

z0 Z-coordinate of the upper-left rectangle corner.

x1 X-coordinate of the lower-right rectangle corner.

y1 Y-coordinate of the lower-right rectangle corner.

z1 Z-coordinate of the lower-right rectangle corner.

color Pointer to **dimv()** (p. 95) consecutive values of type T, defining the drawing color.

opacity Drawing opacity (optional).

Note:

- Clipping is supported.

4.1.4.80 CImg<T>& draw_rectangle (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const tc *const *color*, const float *opacity* = 1.0f)

Draw a 2D filled colored rectangle in the instance image, at coordinates (x0,y0)-(x1,y1).

Parameters:

x0 X-coordinate of the upper-left rectangle corner.

y0 Y-coordinate of the upper-left rectangle corner.

x1 X-coordinate of the lower-right rectangle corner.

y1 Y-coordinate of the lower-right rectangle corner.

color Pointer to **dimv()** (p. 95) consecutive values of type T, defining the drawing color.

opacity Drawing opacity (optional).

Note:

- Clipping is supported.

4.1.4.81 CImg<T>& draw_triangle (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const int *x2*, const int *y2*, const tc *const color, const float *brightness0*, const float *brightness1*, const float *brightness2*, const float *opacity* = 1.0f)

Draw a 2D Gouraud-filled triangle in the instance image, at coordinates (x0,y0)-(x1,y1)-(x2,y2).

Parameters:

x0 = X-coordinate of the first corner in the instance image.
y0 = Y-coordinate of the first corner in the instance image.
x1 = X-coordinate of the second corner in the instance image.
y1 = Y-coordinate of the second corner in the instance image.
x2 = X-coordinate of the third corner in the instance image.
y2 = Y-coordinate of the third corner in the instance image.
color = array of **dimv()** (p. 95) values of type T, defining the global drawing color.
brightness0 = brightness of the first corner (in [0,2]).
brightness1 = brightness of the second corner (in [0,2]).
brightness2 = brightness of the third corner (in [0,2]).
opacity = opacity of the drawing.

Note:

Clipping is supported.

4.1.4.82 CImg<T>& draw_triangle (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const int *x2*, const int *y2*, const CImg< t > & *texture*, const int *tx0*, const int *ty0*, const int *tx1*, const int *ty1*, const int *tx2*, const int *ty2*, const float *opacity* = 1.0f, const float *brightness* = 1.0f)

Draw a 2D textured triangle in the instance image, at coordinates (x0,y0)-(x1,y1)-(x2,y2).

Parameters:

x0 = X-coordinate of the first corner in the instance image.
y0 = Y-coordinate of the first corner in the instance image.
x1 = X-coordinate of the second corner in the instance image.
y1 = Y-coordinate of the second corner in the instance image.
x2 = X-coordinate of the third corner in the instance image.
y2 = Y-coordinate of the third corner in the instance image.
texture = texture image used to fill the triangle.
tx0 = X-coordinate of the first corner in the texture image.
ty0 = Y-coordinate of the first corner in the texture image.
tx1 = X-coordinate of the second corner in the texture image.
ty1 = Y-coordinate of the second corner in the texture image.
tx2 = X-coordinate of the third corner in the texture image.
ty2 = Y-coordinate of the third corner in the texture image.
opacity = opacity of the drawing.
brightness = brightness of the drawing (in [0,2]).

Note:

Clipping is supported, but texture coordinates do not support clipping.

4.1.4.83 CImg<T>& draw_triangle (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const int *x2*, const int *y2*, const tc *const color, const CImg< t > & light, const int lx0, const int ly0, const int lx1, const int ly1, const int lx2, const int ly2, const float opacity* = 1.0f)

Draw a 2D phong-shaded triangle in the instance image, at coordinates (x0,y0)-(x1,y1)-(x2,y2).

Parameters:

x0 = X-coordinate of the first corner in the instance image.

y0 = Y-coordinate of the first corner in the instance image.

x1 = X-coordinate of the second corner in the instance image.

y1 = Y-coordinate of the second corner in the instance image.

x2 = X-coordinate of the third corner in the instance image.

y2 = Y-coordinate of the third corner in the instance image.

color = array of **dimv()** (p. 95) values of type T, defining the global drawing color.

light = light image.

lx0 = X-coordinate of the first corner in the light image.

ly0 = Y-coordinate of the first corner in the light image.

lx1 = X-coordinate of the second corner in the light image.

ly1 = Y-coordinate of the second corner in the light image.

lx2 = X-coordinate of the third corner in the light image.

ly2 = Y-coordinate of the third corner in the light image.

opacity = opacity of the drawing.

Note:

Clipping is supported, but texture coordinates do not support clipping.

4.1.4.84 CImg<T>& draw_triangle (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const int *x2*, const int *y2*, const CImg< t > & *texture*, const int *tx0*, const int *ty0*, const int *tx1*, const int *ty1*, const int *tx2*, const int *ty2*, const float *brightness0*, const float *brightness1*, const float *brightness2*, const float *opacity* = 1)

Draw a 2D textured triangle with Gouraud-Shading in the instance image, at coordinates (x0,y0)-(x1,y1)-(x2,y2).

Parameters:

x0 = X-coordinate of the first corner in the instance image.

y0 = Y-coordinate of the first corner in the instance image.

x1 = X-coordinate of the second corner in the instance image.

y1 = Y-coordinate of the second corner in the instance image.

x2 = X-coordinate of the third corner in the instance image.

y2 = Y-coordinate of the third corner in the instance image.

texture = texture image used to fill the triangle.

tx0 = X-coordinate of the first corner in the texture image.

ty0 = Y-coordinate of the first corner in the texture image.

tx1 = X-coordinate of the second corner in the texture image.

ty1 = Y-coordinate of the second corner in the texture image.

tx2 = X-coordinate of the third corner in the texture image.

ty2 = Y-coordinate of the third corner in the texture image.

brightness0 = brightness value of the first corner.

brightness1 = brightness value of the second corner.

brightness2 = brightness value of the third corner.

opacity = opacity of the drawing.

Note:

Clipping is supported, but texture coordinates do not support clipping.

4.1.4.85 CImg<T>& draw_triangle (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const int *x2*, const int *y2*, const CImg< t > & *texture*, const int *tx0*, const int *ty0*, const int *tx1*, const int *ty1*, const int *tx2*, const int *ty2*, const CImg< tl > & *light*, const int *lx0*, const int *ly0*, const int *lx1*, const int *ly1*, const int *lx2*, const int *ly2*, const float *opacity* = `1.0f`)

Draw a phong-shaded 2D textured triangle in the instance image, at coordinates (`x0`,`y0`)-(`x1`,`y1`)-(`x2`,`y2`).

Parameters:

x0 = X-coordinate of the first corner in the instance image.

y0 = Y-coordinate of the first corner in the instance image.

x1 = X-coordinate of the second corner in the instance image.

y1 = Y-coordinate of the second corner in the instance image.

x2 = X-coordinate of the third corner in the instance image.

y2 = Y-coordinate of the third corner in the instance image.

texture = texture image used to fill the triangle.

tx0 = X-coordinate of the first corner in the texture image.

ty0 = Y-coordinate of the first corner in the texture image.

tx1 = X-coordinate of the second corner in the texture image.

ty1 = Y-coordinate of the second corner in the texture image.

tx2 = X-coordinate of the third corner in the texture image.

ty2 = Y-coordinate of the third corner in the texture image.

light = light image.

lx0 = X-coordinate of the first corner in the light image.

ly0 = Y-coordinate of the first corner in the light image.

lx1 = X-coordinate of the second corner in the light image.

ly1 = Y-coordinate of the second corner in the light image.

lx2 = X-coordinate of the third corner in the light image.

ly2 = Y-coordinate of the third corner in the light image.

opacity = opacity of the drawing.

Note:

Clipping is supported, but texture coordinates do not support clipping.

4.1.4.86 CImg<T>& draw_ellipse (const int *x0*, const int *y0*, const float *r1*, const float *r2*, const float *ru*, const float *rv*, const tc *const color, const float *opacity*, const unsigned int *pattern*)

Draw an outlined ellipse.

Parameters:

x0 = X-coordinate of the ellipse center.

y0 = Y-coordinate of the ellipse center.

r1 = First radius of the ellipse.

r2 = Second radius of the ellipse.

ru = X-coordinate of the orientation vector related to the first radius.

rv = Y-coordinate of the orientation vector related to the first radius.

color = array of **dimv**() (p. 95) values of type `T`, defining the drawing color.

pattern = If zero, the ellipse is filled, else pattern is an integer whose bits describe the outline pattern.

opacity = opacity of the drawing.

4.1.4.87 CImg<T>& draw_ellipse (const int *x0*, const int *y0*, const float *r1*, const float *r2*, const float *ru*, const float *rv*, const tc *const color, const float *opacity* = `1.0f`)

Draw a filled ellipse.

Parameters:

x0 = X-coordinate of the ellipse center.

y0 = Y-coordinate of the ellipse center.

r1 = First radius of the ellipse.

r2 = Second radius of the ellipse.

ru = X-coordinate of the orientation vector related to the first radius.

rv = Y-coordinate of the orientation vector related to the first radius.

color = array of **dimv**() (p. 95) values of type `T`, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.88 CImg<T>& draw_ellipse (const int *x0*, const int *y0*, const CImg< t > & *tensor*, const tc *const color, const float *opacity* = `1.0f`)

Draw a filled ellipse on the instance image.

Parameters:

x0 = X-coordinate of the ellipse center.

y0 = Y-coordinate of the ellipse center.

tensor = Diffusion tensor describing the ellipse.

color = array of **dimv**() (p. 95) values of type `T`, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.89 CImg<T>& draw_ellipse (const int *x0*, const int *y0*, const CImg< t > & *tensor*, const tc *const *color*, const float *opacity*, const unsigned int *pattern*)

Draw an outlined ellipse on the instance image.

Parameters:

x0 = X-coordinate of the ellipse center.

y0 = Y-coordinate of the ellipse center.

tensor = Diffusion tensor describing the ellipse.

color = array of **dimv()** (p. 95) values of type `T`, defining the drawing color.

pattern = If zero, the ellipse is filled, else pattern is an integer whose bits describe the outline pattern.

opacity = opacity of the drawing.

4.1.4.90 CImg<T>& draw_circle (const int *x0*, const int *y0*, int *radius*, const tc *const *color*, const float *opacity* = `1.0f`)

Draw a filled circle on the instance image.

Parameters:

x0 X-coordinate of the circle center.

y0 Y-coordinate of the circle center.

radius Circle radius.

color Array of **dimv()** (p. 95) values of type `T`, defining the drawing color.

opacity Drawing opacity.

Note:

- Circle version of the Bresenham's algorithm is used.

4.1.4.91 CImg<T>& draw_circle (const int *x0*, const int *y0*, int *radius*, const tc *const *color*, const float *opacity*, const unsigned *int*)

Draw an outlined circle.

Parameters:

x0 X-coordinate of the circle center.

y0 Y-coordinate of the circle center.

radius Circle radius.

color Array of **dimv()** (p. 95) values of type `T`, defining the drawing color.

opacity Drawing opacity.

4.1.4.92 CImg<T>& draw_text (const char *const *text*, const int *x0*, const int *y0*, const T *const *fgcolor*, const T *const *bgcolor*, const CImgList< t > & *font*, const float *opacity* = 1.0f)

Draw a text into the instance image.

Parameters:

text = a C-string containing the text to display.

x0 = X-coordinate of the text in the instance image.

y0 = Y-coordinate of the text in the instance image.

fgcolor = an array of **dimv()** (p. 95) values of type `T`, defining the foreground color (0 means 'transparent').

bgcolor = an array of **dimv()** (p. 95) values of type `T`, defining the background color (0 means 'transparent').

font = List of font characters used for the drawing.

opacity = opacity of the drawing.

Note:

Clipping is supported.

See also:

get_font().

4.1.4.93 CImg<T>& draw_text (const char *const *text*, const int *x0*, const int *y0*, const T *const *fgcolor*, const T *const *bgcolor* = 0, const unsigned int *font_size* = 11, const float *opacity* = 1.0f)

Draw a text into the instance image.

Parameters:

text = a C-string containing the text to display.

x0 = X-coordinate of the text in the instance image.

y0 = Y-coordinate of the text in the instance image.

fgcolor = an array of **dimv()** (p. 95) values of type `T`, defining the foreground color (0 means 'transparent').

bgcolor = an array of **dimv()** (p. 95) values of type `T`, defining the background color (0 means 'transparent').

font_size = Height of the desired font (11,13,24,38 or 57)

opacity = opacity of the drawing.

Note:

Clipping is supported.

See also:

get_font().

4.1.4.94 CImg<T>& draw_text (const int *x0*, const int *y0*, const T *const *fgcolor*, const T *const *bgcolor*, const unsigned int *font_size*, const float *opacity*, const char * *format*, ...)

Draw a text into the instance image.

Parameters:

x0 X-coordinate of the text in the instance image.

y0 Y-coordinate of the text in the instance image.

fgcolor Array of **dimv()** (p. 95) values of type `T`, defining the foreground color (0 means 'transparent').

bgcolor Array of **dimv()** (p. 95) values of type `T`, defining the background color (0 means 'transparent').

font_size Size of the font (nearest match).

opacity Drawing opacity.

format 'printf'-style format string, followed by arguments.

Note:

Clipping is supported.

4.1.4.95 CImg<T>& draw_text (const int *x0*, const int *y0*, const T *const *fgcolor*, const T *const *bgcolor*, const CImgList< t > & *font*, const float *opacity*, const char * *format*, ...)

Draw a text into the instance image.

Parameters:

x0 X-coordinate of the text in the instance image.

y0 Y-coordinate of the text in the instance image.

fgcolor Array of **dimv()** (p. 95) values of type `T`, defining the foreground color (0 means 'transparent').

bgcolor Array of **dimv()** (p. 95) values of type `T`, defining the background color (0 means 'transparent').

font Font used for drawing text.

opacity Drawing opacity.

format 'printf'-style format string, followed by arguments.

Note:

Clipping is supported.

4.1.4.96 CImg<T>& draw_quiver (const CImg< t1 > & *flow*, const t2 *const *color*, const unsigned int *sampling* = `25`, const float *factor* = `-20`, const int *quiver_type* = `0`, const float *opacity* = `1.0f`, const unsigned int *pattern* = ~`0U`)

Draw a vector field in the instance image, using a colormap.

Parameters:

flow Image of 2d vectors used as input data.

color Image of **dimv()** (p. 95)-D vectors corresponding to the color of each arrow.

sampling Length (in pixels) between each arrow.

factor Length factor of each arrow (if <0, computed as a percentage of the maximum length).

quiver_type Type of plot. Can be 0 (arrows) or 1 (segments).

opacity Opacity of the drawing.

pattern Used pattern to draw lines.

Note:

Clipping is supported.

4.1.4.97 CImg<T>& draw_quiver (const CImg< t1 > & *flow*, const CImg< t2 > & *color*, const unsigned int *sampling* = 25, const float *factor* = -20, const int *quiver_type* = 0, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U)

Draw a vector field in the instance image, using a colormap.

Parameters:

flow Image of 2d vectors used as input data.

color Image of **dimv()** (p. 95)-D vectors corresponding to the color of each arrow.

sampling Length (in pixels) between each arrow.

factor Length factor of each arrow (if <0, computed as a percentage of the maximum length).

quiver_type Type of plot. Can be 0 (arrows) or 1 (segments).

opacity Opacity of the drawing.

pattern Used pattern to draw lines.

Note:

Clipping is supported.

4.1.4.98 CImg<T>& draw_graph (const CImg< t > & *data*, const tc *const *color*, const unsigned int *gtype* = 1, const double *ymin* = 0, const double *ymax* = 0, const float *opacity* = 1.0f, const unsigned int *pattern* = ~0U)

Draw a 1D graph on the instance image.

Parameters:

data Image containing the graph values I = f(x).

color Array of **dimv()** (p. 95) values of type T, defining the drawing color.

gtype Define the type of the plot :

- 0 = Plot using points clouds.
- 1 = Plot using linear interpolation (segments).
- 2 = Plot with bars.
- 3 = Plot using cubic interpolation (3-polynomials).

ymin Lower bound of the y-range.

ymax Upper bound of the y-range.

opacity Drawing opacity.

pattern Drawing pattern.

Note:

- if `ymin==ymax==0`, the y-range is computed automatically from the input sample.

See also:

draw_axis() (p. 126).

4.1.4.99 CImg<T>& draw_axis (const CImg< t > & *xvalues*, const int *y*, const tc *const *color*, const float *opacity* = `1.0f`, const unsigned int *pattern* = `~0U`)

Draw a labeled horizontal axis on the instance image.

Parameters:

xvalues Lower bound of the x-range.

y Y-coordinate of the horizontal axis in the instance image.

color Array of **dimv()** (p. 95) values of type `T`, defining the drawing color.

opacity Drawing opacity.

pattern Drawing pattern.

Note:

if `precision==0`, precision of the labels is automatically computed.

See also:

draw_graph() (p. 125).

4.1.4.100 CImg<T>& draw_fill (const int *x*, const int *y*, const int *z*, const tc *const *color*, CImg< t > & *region*, const float *sigma* = `0`, const float *opacity* = `1.0f`, const bool *high_connexity* = `false`)

Draw a 3D filled region starting from a point (`x`,`y`,\ `z`) in the instance image.

Parameters:

x X-coordinate of the starting point of the region to fill.

y Y-coordinate of the starting point of the region to fill.

z Z-coordinate of the starting point of the region to fill.

color An array of **dimv()** (p. 95) values of type `T`, defining the drawing color.

region Image that will contain the mask of the filled region mask, as an output.

sigma Tolerance concerning neighborhood values.

opacity Opacity of the drawing.

high_connexity Tells if 8-connexity must be used (only for 2D images).

Returns:

`region` is initialized with the binary mask of the filled region.

4.1.4.101 CImg<T>& draw_fill (const int *x*, const int *y*, const int *z*, const tc *const *color*, const float *sigma* = 0, const float *opacity* = 1.0f, const bool *high_connexity* = false)

Draw a 3D filled region starting from a point (x,y,\ z) in the instance image.

Parameters:

x = X-coordinate of the starting point of the region to fill.
y = Y-coordinate of the starting point of the region to fill.
z = Z-coordinate of the starting point of the region to fill.
color = an array of **dimv()** (p. 95) values of type T, defining the drawing color.
sigma = tolerance concerning neighborhood values.
opacity = opacity of the drawing.

4.1.4.102 CImg<T>& draw_fill (const int *x*, const int *y*, const tc *const *color*, const float *sigma* = 0, const float *opacity* = 1.0f, const bool *high_connexity* = false)

Draw a 2D filled region starting from a point (x,y) in the instance image.

Parameters:

x = X-coordinate of the starting point of the region to fill.
y = Y-coordinate of the starting point of the region to fill.
color = an array of **dimv()** (p. 95) values of type T, defining the drawing color.
sigma = tolerance concerning neighborhood values.
opacity = opacity of the drawing.

4.1.4.103 CImg<T>& draw_plasma (const int *x0*, const int *y0*, const int *x1*, const int *y1*, const double *alpha* = 1.0, const double *beta* = 1.0, const float *opacity* = 1.0f)

Draw a plasma square in the instance image.

Parameters:

x0 = X-coordinate of the upper-left corner of the plasma.
y0 = Y-coordinate of the upper-left corner of the plasma.
x1 = X-coordinate of the lower-right corner of the plasma.
y1 = Y-coordinate of the lower-right corner of the plasma.
alpha = Alpha-parameter of the plasma.
beta = Beta-parameter of the plasma.
opacity = opacity of the drawing.

4.1.4.104 CImg<T>& draw_plasma (const double *alpha* = 1.0, const double *beta* = 1.0, const float *opacity* = 1.0f)

Draw a plasma in the instance image.

Parameters:

alpha = Alpha-parameter of the plasma.
beta = Beta-parameter of the plasma.
opacity = opacity of the drawing.

4.1.4.105 CImg<T>& draw_gaussian (const float *xc*, const double *sigma*, const tc *const *color*, const float *opacity* = 1.0f)

Draw a 1D gaussian function in the instance image.

Parameters:

xc = X-coordinate of the gaussian center.

sigma = Standard variation of the gaussian distribution.

color = array of **dimv()** (p. 95) values of type T, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.106 CImg<T>& draw_gaussian (const float *xc*, const float *yc*, const CImg< t > & *tensor*, const tc *const *color*, const float *opacity* = 1.0f)

Draw an anisotropic 2D gaussian function in the instance image.

Parameters:

xc = X-coordinate of the gaussian center.

yc = Y-coordinate of the gaussian center.

tensor = 2x2 covariance matrix.

color = array of **dimv()** (p. 95) values of type T, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.107 CImg<T>& draw_gaussian (const float *xc*, const float *yc*, const float *sigma*, const tc *const *color*, const float *opacity* = 1.0f)

Draw an isotropic 2D gaussian function in the instance image.

Parameters:

xc = X-coordinate of the gaussian center.

yc = Y-coordinate of the gaussian center.

sigma = standard variation of the gaussian distribution.

color = array of **dimv()** (p. 95) values of type T, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.108 CImg<T>& draw_gaussian (const float *xc*, const float *yc*, const float *zc*, const CImg< t > & *tensor*, const tc *const *color*, const float *opacity* = 1.0f)

Draw an anisotropic 3D gaussian function in the instance image.

Parameters:

xc = X-coordinate of the gaussian center.

yc = Y-coordinate of the gaussian center.

zc = Z-coordinate of the gaussian center.

tensor = 3x3 covariance matrix.

color = array of **dimv()** (p. 95) values of type T, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.109 CImg<T>& draw_gaussian (const float *xc*, const float *yc*, const float *zc*, const double *sigma*, const tc *const *color*, const float *opacity* = 1.0f)

Draw an isotropic 3D gaussian function in the instance image.

Parameters:

xc = X-coordinate of the gaussian center.

yc = Y-coordinate of the gaussian center.

zc = Z-coordinate of the gaussian center.

sigma = standard variation of the gaussian distribution.

color = array of **dimv()** (p. 95) values of type `T`, defining the drawing color.

opacity = opacity of the drawing.

4.1.4.110 CImg<T>& draw_object3d (const float *X*, const float *Y*, const float *Z*, const CImg< tp > & *points*, const CImgList< tf > & *primitives*, const CImgList< tc > & *colors*, const CImgList< to > & *opacities*, const unsigned int *render_type* = 4, const bool *double_sided* = false, const float *focale* = 500, const float *lightx* = 0, const float *lighty* = 0, const float *lightz* = -5000, const float *specular_light* = 0.2f, const float *specular_shine* = 0.1f)

Draw a 3D object in the instance image.

Parameters:

X = X-coordinate of the 3d object position

Y = Y-coordinate of the 3d object position

Z = Z-coordinate of the 3d object position

points = Image N*3 describing 3D point coordinates

primitives = List of P primitives

colors = List of P color (or textures)

opacities = Image of P opacities

render_type = Render type (0=Points, 1=Lines, 2=Faces (no light), 3=Faces (flat), 4=Faces(Gouraud)

double_sided = Tell if object faces have two sides or are oriented.

focale = length of the focale

lightx = X-coordinate of the light

lighty = Y-coordinate of the light

lightz = Z-coordinate of the light

specular_shine = Shininess of the object

4.1.4.111 CImg<typename cimg::superset2<T,t,float>::type> get_correlate (const CImg< t > & *mask*, const unsigned int *cond* = 1, const bool *weighted_correl* = false) const

Compute the correlation of the instance image by a mask.

The correlation of the instance image `*this` by the mask `mask` is defined to be :

res(x,y,z) = sum_{i,j,k} (*this)(x+i,y+j,z+k)*mask(i,j,k)

Parameters:

mask = the correlation kernel.

cond = the border condition type (0=zero, 1=dirichlet)

weighted_correl = enable local normalization.

4.1.4.112 CImg<typename cimg::superset2<T,t,float>::type> get_convolve (const CImg< t > & *mask*, const unsigned int *cond* = 1, const bool *weighted_convol* = false) const

Return the convolution of the image by a mask.

The result `res` of the convolution of an image `img` by a mask `mask` is defined to be :

res(x,y,z) = sum_{i,j,k} img(x-i,y-j,z-k)∗mask(i,j,k)

Parameters:

mask = the correlation kernel.

cond = the border condition type (0=zero, 1=dirichlet)

weighted_convol = enable local normalization.

4.1.4.113 CImg<T> get_noise (const double *sigma* = -20, const unsigned int *ntype* = 0) const

Add noise to the image.

Parameters:

sigma = power of the noise. if sigma<0, it corresponds to the percentage of the maximum image value.

ntype = noise type. can be 0=gaussian, 1=uniform or 2=Salt and Pepper.

Returns:

A noisy version of the instance image.

4.1.4.114 CImg<typename cimg::superset<T,float>::type> get_deriche (const float *sigma*, const int *order* = 0, const char *axe* = 'x', const bool *cond* = true) const

Return the result of the Deriche filter.

The Canny-Deriche filter is a recursive algorithm allowing to compute blurred derivatives of order 0,1 or 2 of an image.

See also:

blur (p. 67)

4.1.4.115 CImg<typename cimg::superset<T,float>::type> get_blur (const float *sigmax*, const float *sigmay*, const float *sigmaz*, const bool *cond* = true) const

Return a blurred version of the image, using a Canny-Deriche filter.

Blur the image with an anisotropic exponential filter (Deriche filter of order 0).

4.1.4.116 CImg<T> get_blur_anisotropic (const CImg< t > & *G*, const float *amplitude* = 60.0f, const float *dl* = 0.8f, const float *da* = 30.0f, const float *gauss_prec* = 2.0f, const unsigned int *interpolation* = 0, const bool *fast_approx* = true) const

Get a blurred version of an image following a field of diffusion tensors.

Parameters:

G = Field of square roots of diffusion tensors used to drive the smoothing.

amplitude = amplitude of the smoothing.

dl = spatial discretization.

da = angular discretization.

gauss_prec = precision of the gaussian function.

interpolation Used interpolation scheme (0 = nearest-neighbor, 1 = linear, 2 = Runge-Kutta)

fast_approx = Tell to use the fast approximation or not.

4.1.4.117 CImg<T> get_blur_anisotropic (const CImg< tm > & *mask*, const float *amplitude*, const float *sharpness* = 0.7f, const float *anisotropy* = 0.3f, const float *alpha* = 0.6f, const float *sigma* = 1.1f, const float *dl* = 0.8f, const float *da* = 30.0f, const float *gauss_prec* = 2.0f, const unsigned int *interpolation* = 0, const bool *fast_approx* = true, const float *geom_factor* = 1.0f) const

Blur an image in an anisotropic way.

Parameters:

mask Binary mask.

amplitude Amplitude of the anisotropic blur.

sharpness Contour preservation.

anisotropy Smoothing anisotropy.

alpha Image pre-blurring (gaussian).

sigma Regularity of the tensor-valued geometry.

dl Spatial discretization.

da Angular discretization.

gauss_prec Precision of the gaussian function.

interpolation Used interpolation scheme (0 = nearest-neighbor, 1 = linear, 2 = Runge-Kutta)

fast_approx Tell to use the fast approximation or not

geom_factor Geometry factor.

4.1.4.118 CImg<T> get_blur_bilateral (const float *sigmax*, const float *sigmay*, const float *sigmaz*, const float *sigmar*, const int *bgridx*, const int *bgridy*, const int *bgridz*, const int *bgridr*, const bool *interpolation* = true) const

Blur an image using the bilateral filter.

Parameters:

sigmax Amount of blur along the X-axis.

sigmay Amount of blur along the Y-axis.

sigmaz Amount of blur along the Z-axis.

sigmar Amount of blur along the range axis.

bgridx Size of the bilateral grid along the X-axis.

bgridy Size of the bilateral grid along the Y-axis.

bgridz Size of the bilateral grid along the Z-axis.

bgridr Size of the bilateral grid along the range axis.

interpolation Use interpolation for image slicing.

Note:

This algorithm uses the optimisation technique proposed by S. Paris and F. Durand, in ECCV'2006 (extended for 3D volumetric images).

4.1.4.119 CImg<typename cimg::superset<T,float>::type> get_haar (const char *axis*, const bool *invert* = `false`, const unsigned int *nb_scales* = `1`) const

Compute the Haar multiscale wavelet transform (monodimensional version).

Parameters:

axis Axis considered for the transform.

invert Set inverse of direct transform.

nb_scales Number of scales used for the transform.

4.1.4.120 CImg<typename cimg::superset<T,float>::type> get_haar (const bool *invert* = `false`, const unsigned int *nb_scales* = `1`) const

Compute the Haar multiscale wavelet transform.

Parameters:

invert Set inverse of direct transform.

nb_scales Number of scales used for the transform.

4.1.4.121 const CImg<T>& display (const int *min_size* = `128`, const int *max_size* = `1024`, const int *print_flag* = `1`) const

Display an image in a window, with a default title. See also.

See also:

display() (p. 76) for details on parameters.

4.1.4.122 CImg<typename cimg::last<T,int>::type> get_coordinates (const int *coords_type*, CImgDisplay & *disp*, unsigned int *const *XYZ* = 0, const unsigned char *const *color* = 0) const

Simple interface to select shaped from an image.

Parameters:

selection Array of 6 values containing the selection result

coords_type Determine shape type to select (0=point, 1=vector, 2=rectangle, 3=circle)

disp Display window used to make the selection

XYZ Initial XYZ position (for volumetric images only)

color Color of the shape selector.

4.1.4.123 static CImg<T> get_load (const char *const *filename*) [static]

Load an image from a file.

Parameters:

filename = name of the image file to load.

Note:

The extension of `filename` defines the file format. If no filename extension is provided, **CImg<T>::get_load()** (p. 133) will try to load a CRAW file (**CImg** (p. 25) Raw file).

4.1.4.124 static CImg<T> get_load_magick (const char *const *filename*) [static]

Load an image using builtin ImageMagick++ Library.

Added April/may 2006 by Christoph Hormann <chris_hormann@gmx.de> This is experimental code, not much tested, use with care.

4.1.4.125 const CImg<T>& save (const char *const *filename*, const int *number* = -1) const

Save the image as a file.

The used file format is defined by the file extension in the filename `filename`.

Parameter `number` can be used to add a 6-digit number to the filename before saving.

If `normalize` is true, a normalized version of the image (between [0,255]) is saved.

4.1.4.126 const CImg<T>& save_imagemagick (const char *const *filename*, const unsigned int *quality* = 100) const

Save the image using ImageMagick's convert.

Function that saves the image for other file formats that are not natively handled by **CImg** (p. 25), using the tool 'convert' from the ImageMagick package.

This is the case for all compressed image formats (GIF,PNG,JPG,TIF, ...). You need to install the ImageMagick package in order to get this function working properly (see `http://www.imagemagick.org`).

4.1.4.127 const CImg<T>& save_graphicsmagick (const char *const *filename*, const unsigned int *quality* = 100) const

Save the image using GraphicsMagick's gm.

Function that saves the image for other file formats that are not natively handled by **CImg** (p. 25), using the tool 'gm' from the GraphicsMagick package.

This is the case for all compressed image formats (GIF,PNG,JPG,TIF, ...). You need to install the GraphicsMagick package in order to get this function working properly (see `http://www.graphicsmagick.org`).

4.1.4.128 const CImg<T>& save_png (std::FILE *const *file*, const char *const *filename* = 0) const

Save an image to a PNG file.

Parameters:

filename = name of the png image file to save

Returns:

*this

Note:

The png format specifies a variety of possible data formats. Grey scale, Grey scale with Alpha, RGB color, RGB color with Alpha, and Palletized color are supported. Per channel bit depths of 1, 2, 4, 8, and 16 are natively supported. The type of file saved depends on the number of channels in the **CImg** (p. 25) file. If there is 4 or more channels, the image will be saved as an RGB color with Alpha image using the bottom 4 channels. If there are 3 channels, the saved image will be an RGB color image. If 2 channels then the image saved will be Grey scale with Alpha, and if 1 channel will be saved as a Grey scale image.

4.1.5 Member Data Documentation

4.1.5.1 unsigned int width

Variable representing the width of the instance image (i.e. dimensions along the X-axis).

Remarks:

- Prefer using the function **CImg<T>::dimx()** (p. 94) to get information about the width of an image.
- Use function **CImg<T>::resize()** (p. 44) to set a new width for an image. Setting directly the variable `width` would probably result in a library crash.
- Empty images have `width` defined to `0`.

4.1.5.2 unsigned int height

Variable representing the height of the instance image (i.e. dimensions along the Y-axis).

Remarks:

- Prefer using the function **CImg<T>::dimy()** (p. 94) to get information about the height of an image.

- Use function **CImg<T>::resize()** (p. 44) to set a new height for an image. Setting directly the variable `height` would probably result in a library crash.
- 1D signals have `height` defined to `1`.
- Empty images have `height` defined to `0`.

4.1.5.3 unsigned int depth

Variable representing the depth of the instance image (i.e. dimensions along the Z-axis).

Remarks:

- Prefer using the function **CImg<T>::dimz()** (p. 94) to get information about the depth of an image.
- Use function **CImg<T>::resize()** (p. 44) to set a new depth for an image. Setting directly the variable `depth` would probably result in a library crash.
- Classical 2D images have `depth` defined to `1`.
- Empty images have `depth` defined to `0`.

4.1.5.4 unsigned int dim

Variable representing the number of channels of the instance image (i.e. dimensions along the V-axis).

Remarks:

- Prefer using the function **CImg<T>::dimv()** (p. 95) to get information about the depth of an image.
- Use function **CImg<T>::resize()** (p. 44) to set a new vector dimension for an image. Setting directly the variable `dim` would probably result in a library crash.
- Scalar-valued images (one value per pixel) have `dim` defined to `1`.
- Empty images have `depth` defined to `0`.

4.2 CImgDisplay Struct Reference

This class represents a window which can display **CImg** (p. 25) images and handles mouse and keyboard events.

Public Member Functions

- **CImgDisplay** ()

  Create an empty display window.

- **CImgDisplay** (const unsigned int dimw, const unsigned int dimh, const char *=**title**=0, const unsigned int normalization_type=3, const unsigned int events_type=3, const bool fullscreen_flag=false, const bool closed_flag=false)

  Create a display window with a specified size `pwidth` *x* `height`.

- template<typename T>
  CImgDisplay (const **CImg**< T > &img, const char *__title__=0, const unsigned int normalization_type=3, const unsigned int events_type=3, const bool fullscreen_flag=false, const bool closed_flag=false)

  Create a display window from an image.

- template<typename T>
  CImgDisplay (const **CImgList**< T > &list, const char *__title__=0, const unsigned int normalization_type=3, const unsigned int events_type=3, const bool fullscreen_flag=false, const bool closed_flag=false)

  Create a display window from an image list.

- **CImgDisplay** (const **CImgDisplay** &disp)

  Create a display window by copying another one.

- ~**CImgDisplay** ()

  Destructor.

- **CImgDisplay** & **operator=** (const **CImgDisplay** &disp)

  Assignment operator.

- bool **is_empty** () const

  Return true is display is empty.

- **operator bool** () const

  Return false if display is empty.

- int **dimx** () const

  Return display width.

- int **dimy** () const

  Return display height.

- int **window_dimx** () const

  Return display window width.

- int **window_dimy** () const

  Return display window height.

- int **window_posx** () const

  Return X-coordinate of the window.

- int **window_posy** () const

  Return Y-coordinate of the window.

- **CImgDisplay** & **wait** (const unsigned int milliseconds)

  Synchronized waiting function. Same as cimg::wait().

- **CImgDisplay** & **wait** ()

  Wait for an event occuring on the current display.

- float **frames_per_second** ()

  Return the frame per second rate.

- template<typename T>
  CImgDisplay & **display** (const **CImgList**< T > &list, const char axe='x', const char align='c')

  Display an image list CImgList<T> into a display window.

- template<typename T>
  CImgDisplay & **operator**<< (const **CImg**< T > &img)

  Display an image CImg<T> into a display window.

- template<typename T>
  CImgDisplay & **operator**<< (const **CImgList**< T > &list)

  Display an image CImg<T> into a display window.

- template<typename T>
  CImgDisplay & **resize** (const **CImg**< T > &img, const bool redraw=true)

  Resize a display window with the size of an image.

- **CImgDisplay** & **resize** (const **CImgDisplay** &disp, const bool redraw=true)

  Resize a display window using the size of the given display `disp`.

- **CImgDisplay** & **resize** (const bool redraw=true)

  Resize a display window in its current size.

- template<typename tp, typename tf, typename tc, typename to>
  CImgDisplay & **display_object3d** (const tp &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const to &opacities, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0)

  Display a 3d object.

- template<typename tp, typename tf, typename tc>
  CImgDisplay & **display_object3d** (const tp &points, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const bool centering=true, const int render_static=4, const int render_motion=1, const bool double_sided=false, const float focale=500.0f, const float specular_light=0.2f, const float specular_shine=0.1f, const bool display_axes=true, float *const pose_matrix=0, const float opacity=1.0f)

  Display a 3D object.

- **CImgDisplay** & **toggle_fullscreen** ()

  Toggle fullscreen mode.

- **CImgDisplay** & **flush** ()

  Clear mouse and key states of the current display.

- bool **is_key** (const bool remove=false)

  Test if any key has been pressed.

- bool **is_key** (const unsigned int key1, const bool remove)

  Test if a key has been pressed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const unsigned int key4, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const unsigned int key4, const unsigned int key5, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const unsigned int key4, const unsigned int key5, const unsigned int key6, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const unsigned int key4, const unsigned int key5, const unsigned int key6, const unsigned int key7, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const unsigned int key4, const unsigned int key5, const unsigned int key6, const unsigned int key7, const unsigned int key8, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int key1, const unsigned int key2, const unsigned int key3, const unsigned int key4, const unsigned int key5, const unsigned int key6, const unsigned int key7, const unsigned int key8, const unsigned int key9, const bool remove)

  Test if a key sequence has been typed.

- bool **is_key** (const unsigned int ∗const keyseq, const unsigned int N, const bool remove=true)

  Test if a key sequence has been typed.

- **CImgDisplay** & **assign** ()

  In-place version of the destructor.

- **CImgDisplay** & **assign** (const unsigned int dimw, const unsigned int dimh, const char ∗**title**=0, const unsigned int normalization_type=3, const unsigned int events_type=3, const bool fullscreen_flag=false, const bool closed_flag=false)

  In-place version of the previous constructor.

- template<typename T>
  CImgDisplay & **assign** (const **CImg**< T > &img, const char ∗**title**=0, const unsigned int normalization_type=3, const unsigned int events_type=3, const bool fullscreen_flag=false, const bool closed_flag=false)

In-place version of the previous constructor.

- template<typename T>
  CImgDisplay & **assign** (const **CImgList**< T > &list, const char *__title__=0, const unsigned int normalization_type=3, const unsigned int events_type=3, const bool fullscreen_flag=false, const bool closed_flag=false)

  In-place version of the previous constructor.

- **CImgDisplay** & **assign** (const **CImgDisplay** &disp)

  In-place version of the previous constructor.

- template<typename T>
  CImgDisplay & **display** (const **CImg**< T > &img)

  Display an image in a window.

- **CImgDisplay** & **resize** (const int **width**, const int **height**, const bool redraw=true)

  Resize window.

- **CImgDisplay** & **move** (const int posx, const int posy)

  Move window.

- **CImgDisplay** & **set_mouse** (const int posx, const int posy)

  Move mouse pointer to a specific location.

- **CImgDisplay** & **hide_mouse** ()

  Hide mouse pointer.

- **CImgDisplay** & **show_mouse** ()

  Show mouse pointer.

- **CImgDisplay** & **show** ()

  Show a closed display.

- **CImgDisplay** & **close** ()

  Close a visible display.

- **CImgDisplay** & **set_title** (const char *format,...)

  Set the window title.

- **CImgDisplay** & **paint** ()

  Re-paint image content in window.

- template<typename T>
  CImgDisplay & **render** (const **CImg**< T > &img)

  Render image buffer into GDI native image format.

- template<typename T>
  const **CImgDisplay** & **snapshot** (**CImg**< T > &img) const

  Take a snapshot of the display in the specified image.

Static Public Member Functions

- static void **wait** (**CImgDisplay** &disp1)

  Wait for any event occuring on the display `disp1`.

- static void **wait** (**CImgDisplay** &disp1, **CImgDisplay** &disp2)

  Wait for any event occuring either on the display `disp1` *or* `disp2`.

- static void **wait** (**CImgDisplay** &disp1, **CImgDisplay** &disp2, **CImgDisplay** &disp3)

  Wait for any event occuring either on the display `disp1`, `disp2` *or* `disp3`.

- static void **wait** (**CImgDisplay** &disp1, **CImgDisplay** &disp2, **CImgDisplay** &disp3, **CImgDisplay** &disp4)

  Wait for any event occuring either on the display `disp1`, `disp2`, `disp3` *or* `disp4`.

- static int **screen_dimx** ()

  Return the width of the screen resolution.

- static int **screen_dimy** ()

  Return the height of the screen resolution.

- static void **wait_all** ()

  Wait for a window event in any ***CImg*** (p. 25) *window.*

Public Attributes

- unsigned int **width**

  Width of the display.

- unsigned int **height**

  Height of the display.

- unsigned int **normalization**

  Normalization type used for the display.

- unsigned int **events**

  Range of events detected by the display.

- char * **title**

  Display title.

- volatile int **window_x**

  X-pos of the display on the screen.

- volatile int **window_y**

  Y-pos of the display on the screen.

- volatile unsigned int **window_width**

  Width of the underlying window.

- volatile unsigned int **window_height**

  Height of the underlying window.

- volatile int **mouse_x**

  X-coordinate of the mouse pointer on the display.

- volatile int **mouse_y**

  Y-coordinate of the mouse pointer on the display.

- volatile unsigned int **buttons** [512]

  Button state of the mouse.

- volatile int **wheel**

  Wheel state of the mouse.

- volatile unsigned int & **key**

  Key value if pressed.

- volatile unsigned int & **released_key**

  Key value if released.

- volatile bool **is_closed**

  Closed state of the window.

- volatile bool **is_resized**

  Resized state of the window.

- volatile bool **is_moved**

  Moved state of the window.

- volatile bool **is_event**

  Event state of the window.

- bool **is_fullscreen**

  Fullscreen state of the display.

4.2.1 Detailed Description

This class represents a window which can display **CImg** (p. 25) images and handles mouse and keyboard events.

Creating a **CImgDisplay** (p. 135) instance opens a window that can be used to display a CImg<T> image of a CImgList<T> image list inside. When a display is created, associated window events (such as mouse motion, keyboard and window size changes) are handled and can be easily detected by testing specific **CImgDisplay** (p. 135) data fields. See **Using Display Windows.** (p. 16) for a complete tutorial on using the **CImgDisplay** (p. 135) class.

4.2.2 Constructor & Destructor Documentation

4.2.2.1 CImgDisplay (const unsigned int *dimw*, const unsigned int *dimh*, const char * *title* = 0, const unsigned int *normalization_type* = 3, const unsigned int *events_type* = 3, const bool *fullscreen_flag* = false, const bool *closed_flag* = false)

Create a display window with a specified size `pwidth` x `height`.

Parameters:

dimw : Width of the display window.

dimh : Height of the display window.

title : Title of the display window.

normalization_type : Normalization type of the display window (see CImgDisplay::normalize).

events_type : Type of events handled by the display window.

fullscreen_flag : Fullscreen mode.

closed_flag : Initially visible mode. A black image will be initially displayed in the display window.

4.2.2.2 CImgDisplay (const CImg< T > & *img*, const char * *title* = 0, const unsigned int *normalization_type* = 3, const unsigned int *events_type* = 3, const bool *fullscreen_flag* = false, const bool *closed_flag* = false)

Create a display window from an image.

Parameters:

img : Image that will be used to create the display window.

title : Title of the display window

normalization_type : Normalization type of the display window.

events_type : Type of events handled by the display window.

fullscreen_flag : Fullscreen mode.

closed_flag : Initially visible mode.

4.2.2.3 CImgDisplay (const CImgList< T > & *list*, const char * *title* = 0, const unsigned int *normalization_type* = 3, const unsigned int *events_type* = 3, const bool *fullscreen_flag* = false, const bool *closed_flag* = false)

Create a display window from an image list.

Parameters:

list : The list of images to display.

title : Title of the display window

normalization_type : Normalization type of the display window.

events_type : Type of events handled by the display window.

fullscreen_flag : Fullscreen mode.

closed_flag : Initially visible mode.

4.2.2.4 CImgDisplay (const CImgDisplay & *disp*)

Create a display window by copying another one.

Parameters:

disp : Display window to copy.

4.2.3 Member Function Documentation

4.2.3.1 CImgDisplay& wait (const unsigned int *milliseconds*)

Synchronized waiting function. Same as cimg::wait().

See also:

cimg::wait()

4.2.3.2 CImgDisplay& display (const CImgList< T > & *list*, const char *axe* = 'x', const char *align* = 'c')

Display an image list CImgList<T> into a display window.

First, all images of the list are appended into a single image used for visualization, then this image is displayed in the current display window.

Parameters:

list : The list of images to display.

axe : The axe used to append the image for visualization. Can be 'x' (default),'y','z' or 'v'.

align : Defines the relative alignment of images when displaying images of different sizes. Can be 'c' (centered, which is the default), 'p' (top alignment) and 'n' (bottom aligment).

See also:

CImg::get_append() (p. 49)

4.2.3.3 CImgDisplay& resize (const CImg< T > & *img*, const bool *redraw* = true)

Resize a display window with the size of an image.

Parameters:

img : Input image. `image.width` and `image.height` give the new dimensions of the display window.

redraw : If `true` (default), the current displayed image in the display window will be bloc-interpolated to fit the new dimensions. If `false`, a black image will be drawn in the resized window.

4.3 CImgException Struct Reference

Class which is thrown when an error occured during a CImg library function call.

Inherited by CImgArgumentException, CImgDisplayException, CImgInstanceException, CImgIOException, and CImgWarningException.

Public Attributes

- char **message** [1024]

  Message associated with the error that thrown the exception.

4.3.1 Detailed Description

Class which is thrown when an error occured during a CImg library function call.

4.3.2 Overview

CImgException (p. 143) is the base class of CImg exceptions. Exceptions are thrown by the CImg Library when an error occured in a CImg library function call. **CImgException** (p. 143) is seldom thrown itself. Children classes that specify the kind of error encountered are generally used instead. These sub-classes are :

- **CImgInstanceException** : Thrown when the instance associated to the called CImg function is not correctly defined. Generally, this exception is thrown when one tries to process *empty* images. The example below will throw a *CImgInstanceException*.

```
CImg<float> img;        // Construct an empty image.
img.blur(10);           // Try to blur the image.
```

- **CImgArgumentException** : Thrown when one of the arguments given to the called CImg function is not correct. Generally, this exception is thrown when arguments passed to the function are outside an admissible range of values. The example below will throw a *CImgArgumentException*.

```
CImg<float> img(100,100,1,3);   // Define a 100x100 color image with float pixels.
img = 0;                       // Try to fill pixels from the 0 pointer (invalid argument to oper
```

- **CImgIOException** : Thrown when an error occured when trying to load or save image files. The example below will throw a *CImgIOException*.

```
CImg<float> img("file_doesnt_exist.jpg");    // Try to load a file that doesn't exist.
```

- **CImgDisplayException** : Thrown when an error occured when trying to display an image in a window. This exception is thrown when image display request cannot be satisfied.

The parent class **CImgException** (p. 143) may be thrown itself when errors that cannot be classified in one of the above type occur. It is recommended not to throw CImgExceptions yourself, since there are normally reserved to CImg Library functions. **CImgInstanceException**, **CImgArgumentException**, **CImgIOException** and **CImgDisplayException** are simple subclasses of **CImgException** (p. 143) and are thus not detailled more in this reference documentation.

4.3.3 Exception handling

When an error occurs, the CImg Library first displays the error in a modal window. Then, it throws an instance of the corresponding exception class, generally leading the program to stop (this is the default behavior). You can bypass this default behavior by handling the exceptions yourself, using a code block `try { ... } catch() { ... }`. In this case, you can avoid the apparition of the modal window, by defining the environment variable `cimg_debug` to 0 before including the CImg header file. The example below shows how to cleanly handle CImg Library exceptions :

```
#define cimg_debug 0     // Disable modal window in CImg exceptions.
#define "CImg.h"
int main() {
  try {
    ...; // Here, do what you want.
  }
  catch (CImgInstanceException &e) {
    std::fprintf(stderr,"CImg Library Error : %s",e.message);  // Display your own error message
    ...                                                        // Do what you want now.
  }
}
```

4.4 CImgList Struct Template Reference

Class representing list of images CImg<T>.

Constructors - Destructor - Copy

- **CImgList** ()

  Default constructor.

- ~**CImgList** ()

  Destructor.

- **CImgList**< T > & **assign** ()

  In-place version of the default constructor and default destructor.

- **CImgList**< T > & **clear** ()

  *Equivalent to **assign()** (p. 145) (STL-compliant name).*

- template<typename t>
  CImgList (const **CImgList**< t > &list)

  Copy constructor.

- **CImgList** (const **CImgList**< T > &list)
- template<typename t>
  CImgList (const **CImgList**< t > &list, const bool shared)

  Copy constructor that create a shared object.

- **CImgList** (const **CImgList**< T > &list, const bool shared)
- template<typename t>
  CImgList< T > & **assign** (const **CImgList**< t > &list, const int shared=0)

  In-place version of the copy constructor.

- **CImgList** (const unsigned int n)

  Construct an image list containing n empty images.

- **CImgList**< T > & **assign** (const unsigned int n)

  In-place version of the previous constructor.

- **CImgList** (const unsigned int n, const unsigned int width, const unsigned int height=1, const unsigned int depth=1, const unsigned int dim=1)

Construct an image list containing n images with specified size.

- **CImgList**< T > & **assign** (const unsigned int n, const unsigned int width, const unsigned int height=1, const unsigned int depth=1, const unsigned int dim=1)

  In-place version of the previous constructor.

- **CImgList** (const unsigned int n, const unsigned int width, const unsigned int height, const unsigned int depth, const unsigned int dim, const T val)

  Construct an image list containing n images with specified size, filled with val.

- **CImgList**< T > & **assign** (const unsigned int n, const unsigned int width, const unsigned int height, const unsigned int depth, const unsigned int dim, const T val)

  In-place version of the previous constructor.

- **CImgList** (const unsigned int n, const unsigned int width, const unsigned int height, const unsigned int depth, const unsigned int dim, const int val0, const int val1,...)

  Construct an image list containing n images with specified size and specified pixel values (int version).

- **CImgList**< T > & **assign** (const unsigned int n, const unsigned int width, const unsigned int height, const unsigned int depth, const unsigned int dim, const int val0, const int val1,...)

  In-place version of the previous constructor.

- **CImgList** (const unsigned int n, const unsigned int width, const unsigned int height, const unsigned int depth, const unsigned int dim, const double val0, const double val1,...)

  Construct an image list containing n images with specified size and specified pixel values (double version).

- **CImgList**< T > & **assign** (const unsigned int n, const unsigned int width, const unsigned int height, const unsigned int depth, const unsigned int dim, const double val0, const double val1,...)

  In-place version of the previous constructor.

- template<typename t>
  CImgList (const unsigned int n, const **CImg**< t > &img, const bool shared=false)

  Construct a list containing n copies of the image img.

- template<typename t>
  CImgList< T > & **assign** (const unsigned int n, const **CImg**< t > &img, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t>
  CImgList (const **CImg**< t > &img, const bool shared=false)

  Construct an image list from one image.

- template<typename t>
  CImgList< T > & **assign** (const **CImg**< t > &img, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const bool shared=false)

  Construct an image list from two images.

- template<typename t1, typename t2>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2, typename t3>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const bool shared=false)

  Construct an image list from three images.

- template<typename t1, typename t2, typename t3>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2, typename t3, typename t4>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const bool shared=false)

  Construct an image list from four images.

- template<typename t1, typename t2, typename t3, typename t4>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2, typename t3, typename t4, typename t5>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const bool shared=false)

  Construct an image list from five images.

- template<typename t1, typename t2, typename t3, typename t4, typename t5>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2, typename t3, typename t4, typename t5, typename t6>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const **CImg**< t6 > &img6, const bool shared=false)

  Construct an image list from six images.

- template<typename t1, typename t2, typename t3, typename t4, typename t5, typename t6>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const **CImg**< t6 > &img6, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2, typename t3, typename t4, typename t5, typename t6, typename t7>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const **CImg**< t6 > &img6, const **CImg**< t7 > &img7, const bool shared=false)

Construct an image list from seven images.

- template<typename t1, typename t2, typename t3, typename t4, typename t5, typename t6, typename t7>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const **CImg**< t6 > &img6, const **CImg**< t7 > &img7, const bool shared=false)

  In-place version of the previous constructor.

- template<typename t1, typename t2, typename t3, typename t4, typename t5, typename t6, typename t7, typename t8>
  CImgList (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const **CImg**< t6 > &img6, const **CImg**< t7 > &img7, const **CImg**< t8 > &img8, const bool shared=false)

  Construct an image list from eight images.

- template<typename t1, typename t2, typename t3, typename t4, typename t5, typename t6, typename t7, typename t8>
  CImgList< T > & **assign** (const **CImg**< t1 > &img1, const **CImg**< t2 > &img2, const **CImg**< t3 > &img3, const **CImg**< t4 > &img4, const **CImg**< t5 > &img5, const **CImg**< t6 > &img6, const **CImg**< t7 > &img7, const **CImg**< t8 > &img8, const bool shared=false)

  In-place version of the previous constructor.

- **CImgList** (const char *const filename)

  Construct an image list from a filename.

- **CImgList**< T > & **assign** (const char *const filename)

  In-place version of the previous constructor.

- **CImgList**< T > & **swap** (**CImgList**< T > &list)
- **CImgList**< T > & **transfer_to** (**CImgList**< T > &list)
- template<typename t>
  CImgList< T > & **transfer_to** (**CImgList**< t > &list)
- bool **is_empty** () const

  Return `true` *if list is empty.*

- **operator bool** () const
- bool **contains** (const int k) const

  Return `true` *if the list contains an image with indice k.*

- bool **contains** (const int k, const int x, const int y=0, const int z=0, const int v=0) const

  Return `true` *if the k-th image of the list contains the pixel (x,y,z,v).*

- template<typename t>
  bool **contains** (const T &pixel, t &l, t &x, t &y, t &z, t &v) const

  Return `true` *if one of the image list contains the pixel.*

- template<typename t>
  bool **contains** (const T &pixel, t &l, t &x, t &y, t &z) const

  Return `true` *if one of the image list contains the pixel.*

- template<typename t>
  bool **contains** (const T &pixel, t &l, t &x, t &y) const

  Return `true` *if one of the image list contains the pixel.*

- template<typename t>
  bool **contains** (const T &pixel, t &l, t &x) const

  Return `true` *if one of the image list contains the pixel.*

- template<typename t>
  bool **contains** (const T &pixel, t &l) const

  Return `true` *if one of the image list contains the pixel.*

- template<typename t>
  bool **contains** (const T &pixel) const

  Return `true` *if one of the image list contains the pixel.*

- static const char * **pixel_type** ()

  Return a string describing the type of the image pixels in the list (template parameter `T`*).*

Arithmetics Operators

- template<typename t>
  CImgList< T > & **operator=** (const **CImgList**< t > &list)

  Assignment operator.

- **CImgList**< T > & **operator=** (const **CImgList**< T > &list)
- template<typename t>
  CImgList< T > & **operator=** (const **CImg**< t > &img)

  Assignment operator.

- **CImgList**< T > & **operator=** (const T val)

  Assignment operator.

- **CImgList**< T > **operator+** () const

  Operator+.

- template<typename t>
  CImgList< T > & **operator+=** (const t val)

  Operator+=.

- template<typename t>
  CImgList< T > & **operator+=** (const **CImgList**< t > &list)

  Operator+=.

- **CImgList**< T > & **operator++** ()

  Operator++ (prefix).

- **CImgList**< T > **operator++** (int)

  Operator++ (postfix).

- **CImgList**< T > **operator-** () const

  Operator-.

- template<typename t>
  CImgList< T > & **operator-=** (const t val)

  Operator-=.

- template<typename t>
  CImgList< T > & **operator-=** (const **CImgList**< t > &list)

  Operator-=.

- **CImgList**< T > & **operator–** ()

  Operator– (prefix).

- **CImgList**< T > **operator–** (int)

  Operator– (postfix).

- template<typename t>
  CImgList< T > & **operator*=** (const t val)

  Operator=.*

- template<typename t>
  CImgList< T > & **operator*=** (const **CImgList**< t > &list)

  Operator=.*

- template<typename t>
  CImgList< T > & **operator/=** (const t val)

  Operator/=.

- template<typename t>
  CImgList< T > & **operator/=** (const **CImgList**< t > &list)

  Operator/=.

- const T & **max** () const

  Return a reference to the maximum pixel value of the instance image.

- T & **max** ()

  Return a reference to the maximum pixel value of the instance image.

- const T & **min** () const

  Return a reference to the minimum pixel value of the instance image.

- T & **min** ()

  Return a reference to the minimum pixel value of the instance image.

- template<typename t>
  const T & **minmax** (t &max_val) const

  Return a reference to the minimum pixel value of the instance image.

- template<typename t>
  T & **minmax** (t &max_val)

  Return a reference to the minimum pixel value of the instance image.

- template<typename t>
  const T & **maxmin** (t &min_val) const

  Return a reference to the minimum pixel value of the instance image.

- template<typename t>
  T & **maxmin** (t &min_val)

  Return a reference to the minimum pixel value of the instance image.

- double **mean** () const

  Return the mean pixel value of the instance image.

- double **variance** ()

  Return the variance of the image.

List Manipulation

- **CImg**< T > & **operator[ ]** (const unsigned int pos)

  Return a reference to the i-th element of the image list.

- const **CImg**< T > & **operator[ ]** (const unsigned int pos) const
- **CImg**< T > & **operator()** (const unsigned int pos)

  Equivalent to CImgList<T>::operator[].

- const **CImg**< T > & **operator()** (const unsigned int pos) const
- T & **operator()** (const unsigned int pos, const unsigned int x, const unsigned int y=0, const unsigned int z=0, const unsigned int v=0)

  Return a reference to (x,y,z,v) pixel of the pos-th image of the list.

- const T & **operator()** (const unsigned int pos, const unsigned int x, const unsigned int y=0, const unsigned int z=0, const unsigned int v=0) const
- **CImg**< T > & **at** (const unsigned int pos)

  Equivalent to CImgList<T>::operator[], with boundary checking.

- const **CImg**< T > & **at** (const unsigned int pos) const
- **CImg**< T > & **back** ()

  Returns a reference to last element.

- const **CImg**< T > & **back** () const
- **CImg**< T > & **front** ()

  Returns a reference to the first element.

- const **CImg**< T > & **front** () const
- **iterator begin** ()

  Returns an iterator to the beginning of the vector.

- **const_iterator begin** () const
- **iterator end** ()

  Returns an iterator just past the last element.

- **const_iterator end** () const
- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **get_insert** (const **CImg**< t > &img, const unsigned int pos=~0U, const bool shared=false) const

  Insert a copy of the image `img` *into the current image list, at position* `pos`.

- template<typename t>
  CImgList< T > & **insert** (const **CImg**< t > &img, const unsigned int pos, const bool shared)

  In-place version of the previous function.

- **CImgList**< T > & **insert** (const **CImg**< T > &img, const unsigned int pos, const bool shared)
- template<typename t>
  CImgList< T > & **insert** (const **CImg**< t > &img, const unsigned int pos)
- template<typename t>
  CImgList< T > & **insert** (const **CImg**< t > &img)

  In-place version of the previous function.

- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **get_insert** (const unsigned int n, const **CImg**< t > &img, const unsigned int pos=~0U, const bool shared=false) const

  Insert n copies of the image `img` *into the current image list, at position* `pos`.

- template<typename t>
  CImgList< T > & **insert** (const unsigned int n, const **CImg**< t > &img, const unsigned int pos=~0U, const bool shared=false)

  In-place version of the previous function.

- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **get_insert** (const **CImgList**< t > &list, const unsigned int pos=~0U, int shared=0) const

  Insert a copy of the image list `list` *into the current image list, starting from position* `pos`.

- template<typename t>
  CImgList< T > & **insert** (const **CImgList**< t > &list, const unsigned int pos=~0U, const int shared=0)

  In-place version of the previous function.

- template<typename t>
  CImgList< typename cimg::superset< T, t >::type > **get_insert** (const unsigned int n, const **CImgList**< t > &list, const unsigned int pos=~0U, const int shared=0) const

  Insert n copies of the list `list` *at position* `pos` *of the current list.*

- template<typename t>
  CImgList< T > & **insert** (const unsigned int n, const **CImgList**< t > &list, const unsigned int pos=~0U, const int shared=0)

  In-place version of the previous function.

- **CImgList**< T > **get_remove** (const unsigned int pos1, const unsigned int pos2) const

  Remove the images at positions `pos1` *to* `pos2` *from the image list.*

- **CImgList**< T > & **remove** (const unsigned int pos1, const unsigned int pos2)

  In-place version of the previous function.

- **CImgList**< T > **get_remove** (const unsigned int pos) const

  Remove the image at position `pos` *from the image list.*

- **CImgList**< T > & **remove** (const unsigned int pos)

  In-place version of the previous function.

- **CImgList**< T > **get_remove** () const

  Remove the last image from the image list.

- **CImgList**< T > & **remove** ()

  In-place version of the previous function.

- **CImgList**< T > **get_reverse** () const

  Reverse list order.

- **CImgList**< T > & **reverse** ()

  In-place version of the previous function.

- **CImgList**< T > **get_crop** (const unsigned int i0, const unsigned int i1, const bool shared=false) const

  Get a sub-list.

- **CImgList**< T > & **crop** (const unsigned int i0, const unsigned int i1, const bool shared=false)

  In-place version of the previous function.

- **CImgList**< T > **get_crop** (const unsigned int i0, const unsigned int i1, const int x0, const int y0, const int z0, const int v0, const int x1, const int y1, const int z1, const int v1) const

  Get sub-images of a sublist.

- **CImgList**< T > & **crop** (const unsigned int i0, const unsigned int i1, const int x0, const int y0, const int z0, const int v0, const int x1, const int y1, const int z1, const int v1)

  In-place version of the previous function.

- **CImgList**< T > **get_crop** (const unsigned int i0, const unsigned int i1, const int x0, const int y0, const int z0, const int x1, const int y1, const int z1) const

  Get sub-images of a sublist.

- **CImgList**< T > & **crop** (const unsigned int i0, const unsigned int i1, const int x0, const int y0, const int z0, const int x1, const int y1, const int z1)

  In-place version of the previous function.

- **CImgList**< T > **get_crop** (const unsigned int i0, const unsigned int i1, const int x0, const int y0, const int x1, const int y1) const

  Get sub-images of a sublist.

- **CImgList**< T > & **crop** (const unsigned int i0, const unsigned int i1, const int x0, const int y0, const int x1, const int y1)

In-place version of the previous function.

- **CImgList**< T > **get_crop** (const unsigned int i0, const unsigned int i1, const int x0, const int x1) const

  Get sub-images of a sublist.

- **CImgList**< T > & **crop** (const unsigned int i0, const unsigned int i1, const int x0, const int x1)

  In-place version of the previous function.

- template<typename t>
  CImgList< T > & **operator**<< (const **CImg**< t > &img)

  Insert a copy of the image `img` *at the end of the current image list.*

- template<typename t>
  CImgList< T > & **operator**<< (const **CImgList**< t > &list)

  Insert a copy of the image list `list` *at the end of the current image list.*

- template<typename t>
  CImgList< T > & **operator**>> (**CImg**< t > &img) const

  Return a copy of the current image list, where the image `img` *has been inserted at the end.*

- template<typename t>
  CImgList< T > & **operator**>> (**CImgList**< t > &list) const

  Insert a copy of the current image list at the beginning of the image list `list`.

- const **CImgList**< T > & **operator**>> (**CImgDisplay** &disp) const

  Display an image list into a ***CImgDisplay*** *(*p. *135)*.

- template<typename t>
  CImgList< T > & **push_back** (const **CImg**< t > &img)

  Insert image `img` *at the end of the list.*

- template<typename t>
  CImgList< T > & **push_front** (const **CImg**< t > &img)

  Insert image `img` *at the front of the list.*

- template<typename t>
  CImgList< T > & **push_back** (const **CImgList**< t > &list)

  Insert list `list` *at the end of the current list.*

- template<typename t>
  CImgList< T > & **push_front** (const **CImgList**< t > &list)

  Insert list `list` *at the front of the current list.*

- **CImgList**< T > & **pop_back** ()

  Remove last element of the list;.

- **CImgList**< T > & **pop_front** ()

  Remove first element of the list;.

- **CImgList**< T > & **erase** (const **iterator** iter)

Remove the element pointed by iterator `iter;`.

Fourier Transforms

- **CImgList**< typename cimg::superset< T, float >::type > **get_FFT** (const char axe, const bool invert=false) const

  Compute the Fast Fourier Transform (along the specified axis).

- **CImgList**< T > & **FFT** (const char axe, const bool invert=false)

  In-place version of the previous function.

- **CImgList**< typename cimg::superset< T, float >::type > **get_FFT** (const bool invert=false) const

  Compute the Fast Fourier Transform of a complex image.

- **CImgList**< T > & **FFT** (const bool invert=false)

  In-place version of the previous function.

Input-Output and Display

- const **CImgList**< T > & **print** (const char *title=0, const int print_flag=1) const

  Print informations about the list on the standard output.

- const **CImgList**< T > & **print** (const int print_flag) const

  Display informations about the list on the standard output.

- **CImgList**< T > & **load** (const char *const filename)

  In-place version of the previous function.

- **CImgList**< T > & **load_cimg** (std::FILE *const file, const char *const filename=0)

  In-place version of the previous function.

- **CImgList**< T > & **load_cimg** (const char *const filename)

  In-place version of the previous function.

- **CImgList**< T > & **load_cimg** (std::FILE *const file, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1)

  In-place version of the previous function.

- **CImgList**< T > & **load_cimg** (const char *const filename, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1)

  In-place version of the previous function.

- **CImgList**< T > & **load_cimg** (std::FILE *const file, const char *const filename, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1)

In-place version of the previous function.

- **CImgList**< T > & **load_parrec** (const char *const filename)

  In-place version of the previous function.

- **CImgList**< T > & **load_yuv** (std::FILE *const file, const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false)

  In-place version of the previous function.

- **CImgList**< T > & **load_yuv** (const char *const filename, const unsigned int sizex, const unsigned int sizey, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false)

  In-place version of the previous function.

- **CImgList**< T > & **load_ffmpeg** (const char *const filename)

  In-place version of the previous function.

- template<typename tf, typename tc>
  CImgList< T > & **load_off** (std::FILE *const file, const char *const filename, **CImgList**< tf > &primitives, **CImgList**< tc > &colors, const bool invert_faces=false)

  In-place version of the previous function.

- template<typename tf, typename tc>
  CImgList< T > & **load_off** (const char *const filename, **CImgList**< tf > &primitives, **CImgList**< tc > &colors, const bool invert_faces=false)

  In-place version of the previous function.

- **CImgList**< T > **get_load_tiff** (const char *const filename, const unsigned int first_frame=0, const unsigned int last_frame=~0U) const

  Load a (possibly multi-page) tiff file.

- **CImgList**< T > & **load_tiff** (const char *const filename, const unsigned int first_frame=0, const unsigned int last_frame=~0U)

  In-place version of the previous function.

- const **CImgList**< T > & **save** (const char *const filename, const int number=-1) const

  Save an image list into a file.

- const **CImgList**< T > & **save_yuv** (std::FILE *const file, const char *const filename=0, const bool rgb2yuv=true) const

  Save an image sequence into a YUV file.

- const **CImgList**< T > & **save_yuv** (const char *const filename=0, const bool rgb2yuv=true) const

  Save an image sequence into a YUV file.

- const **CImgList**< T > & **save_ffmpeg** (const char *const filename, const char *const codec="mpeg2video") const

  Save an image sequence using the external tool 'ffmpeg'.

- const **CImgList**< T > & **save_cimg** (std::FILE *const file, const char *const filename=0) const

  *Save an image list into a **.cimg** (p. 20) file.*

- const **CImgList**< T > & **save_cimg** (const char *const filename) const

  *Save an image list into a **CImg** (p. 25) file (RAW binary file + simple header).*

- const **CImgList**< T > & **save_cimg** (std::FILE *const file, const char *const filename, const unsigned int n0, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0) const
- const **CImgList**< T > & **save_cimg** (std::FILE *const file, const unsigned int n0, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0) const

  *Insert the instance image into into an existing **.cimg** (p. 20) file, at specified coordinates.*

- const **CImgList**< T > & **save_cimg** (const char *const filename, const unsigned int n0, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0) const

  *Insert the instance image into into an existing **.cimg** (p. 20) file, at specified coordinates.*

- template<typename tf, typename tc>
  const **CImgList**< T > & **save_off** (std::FILE *const file, const char *const filename, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const bool invert_faces=false) const

  Save an image list into a OFF file.

- template<typename tf, typename tc>
  const **CImgList**< T > & **save_off** (const char *const filename, const **CImgList**< tf > &primitives, const **CImgList**< tc > &colors, const bool invert_faces=false) const

  Save an image list into a OFF file.

- **CImgList**< T > **get_split** (const char axe='x') const
- **CImgList**< T > & **split** (const char axe='x')

  In-place version of the previous function.

- **CImg**< T > **get_append** (const char axe='x', const char align='c') const

  *Return a single image which is the concatenation of all images of the current **CImgList** (p. 145) instance.*

- **CImgList**< T > **get_crop_font** () const
- **CImgList**< T > & **crop_font** ()

  In-place version of the previous function.

- **CImgList**< T > & **font** (const unsigned int *const font, const unsigned int w, const unsigned int h, const unsigned int paddingx, const unsigned int paddingy, const bool variable_size=true)

  In-place version of the previous function.

- **CImgList**< T > & **font** (const unsigned int font_width, const bool variable_size=true)

  In-place version of the previous function.

- const **CImgList**< T > & **display** (**CImgDisplay** &disp, const char axe='x', const char align='c') const

  *Display the current **CImgList** (p. 145) instance in an existing **CImgDisplay** (p. 135) window (by reference).*

- const **CImgList**< T > & **display** (const char *title, const char axe='x', const char align='c', const int min_size=128, const int max_size=1024, const int print_flag=1) const

  *Display the current **CImgList** (p. 145) instance in a new display window.*

- const **CImgList**< T > & **display** (const char axe='x', const char align='c', const int min_size=128, const int max_size=1024, const int print_flag=1) const

  *Display the current **CImgList** (p. 145) instance in a new display window.*

- static **CImgList**< T > **get_load** (const char *const filename)

  Load an image list from a file.

- static **CImgList**< T > **get_load_cimg** (std::FILE *const file, const char *const filename=0)

  *Load an image list from a **.cimg** (p. 20) file.*

- static **CImgList**< T > **get_load_cimg** (const char *const filename)

  *Load an image list from a **.cimg** (p. 20) file.*

- static **CImgList**< T > **get_load_cimg** (std::FILE *const file, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1)

  *Load a sub-image list from a **.cimg** (p. 20) file.*

- static **CImgList**< T > **get_load_cimg** (const char *const filename, const unsigned int n0, const unsigned int n1, const unsigned int x0, const unsigned int y0, const unsigned int z0, const unsigned int v0, const unsigned int x1, const unsigned int y1, const unsigned int z1, const unsigned int v1)

  *Load a sub-image list from a **.cimg** (p. 20) file.*

- static **CImgList**< T > **get_load_parrec** (const char *const filename)

  Load an image list from a PAR/REC (Philips) file.

- static **CImgList**< T > **get_load_yuv** (std::FILE *const file, const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false)

  Load an image sequence from a YUV file.

- static **CImgList**< T > **get_load_yuv** (const char *const filename, const unsigned int sizex, const unsigned int sizey=1, const unsigned int first_frame=0, const int last_frame=-1, const bool yuv2rgb=false)

  Load an image sequence from a YUV file.

- static **CImgList**< T > **get_load_ffmpeg** (const char *const filename)

  Load an image from a video file (MPEG,AVI) using the external tool 'ffmpeg'.

- template<typename tf, typename tc>
  static **CImgList**< T > **get_load_off** (std::FILE *const file, const char *const filename, **CImgList**< tf > &primitives, **CImgList**< tc > &colors, const bool invert_faces=false)

  Load a 3D object from a .OFF file (GeomView 3D object files).

- template<typename tf, typename tc>
  static **CImgList**< T > **get_load_off** (const char *const filename, **CImgList**< tf > &primitives, **CImgList**< tc > &colors, const bool invert_faces=false)

  Load a 3D object from a .OFF file (GeomView 3D object files).

- static void **save_empty_cimg** (std::FILE *const file, const char *const filename, const unsigned int nb, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

- static void **save_empty_cimg** (std::FILE *const file, const unsigned int nb, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  *Create an empty **.cimg** (p. 20) file with specified dimensions.*

- static void **save_empty_cimg** (const char *const filename, const unsigned int nb, const unsigned int dx, const unsigned int dy=1, const unsigned int dz=1, const unsigned int dv=1)

  *Create an empty **.cimg** (p. 20) file with specified dimensions.*

- static **CImgList**< T > **get_font** (const unsigned int *const font, const unsigned int w, const unsigned int h, const unsigned int paddingx, const unsigned int paddingy, const bool variable_size=true)
- static **CImgList**< T > **get_font** (const unsigned int font_width, const bool variable_size=true)

  *Return a **CImg** (p. 25) pre-defined font with desired size.*

Public Types

- typedef **CImg**< T > * **iterator**

  *Define a **CImgList<T>::iterator** (p. 159).*

- typedef const **CImg**< T > * **const_iterator**

  *Define a **CImgList<T>::const_iterator** (p. 159).*

- typedef T **value_type**

  Get value type.

Public Attributes

- unsigned int **size**

  Size of the list (number of elements inside).

- unsigned int **allocsize**

  Allocation size of the list.

- **CImg**< T > * **data**

  Pointer to the first list element.

4.4.1 Detailed Description

template<typename T> struct cimg_library::CImgList< T >

Class representing list of images CImg<T>.

4.4.2 Member Function Documentation

4.4.2.1 const CImgList<T>& save (const char *const *filename*, const int *number* = -1) const

Save an image list into a file.

Depending on the extension of the given filename, a file format is chosen for the output file.

4.4.2.2 const CImgList<T>& save_cimg (std::FILE *const *file*, const char *const *filename* = 0) const

Save an image list into a **.cimg** (p. 20) file.

A **CImg** (p. 25) RAW file is a simple uncompressed binary file that may be used to save list of CImg<T> images.

Parameters:

filename : name of the output file.

Returns:

A reference to the current **CImgList** (p. 145) instance is returned.

4.4.2.3 CImg<T> get_append (const char *axe* = 'x', const char *align* = 'c') const

Return a single image which is the concatenation of all images of the current **CImgList** (p. 145) instance.

Parameters:

axe : specify the axe for image concatenation. Can be 'x','y','z' or 'v'.

align : specify the alignment for image concatenation. Can be 'p' (top), 'c' (center) or 'n' (bottom).

Returns:

A CImg<T> image corresponding to the concatenation is returned.

4.4.2.4 static CImgList<T> get_font (const unsigned int *font_width*, const bool *variable_size* = true) [static]

Return a **CImg** (p. 25) pre-defined font with desired size.

Parameters:

font_height = height of the desired font (can be 11,13,24,38 or 57)

fixed_size = tell if the font has a fixed or variable width.

4.4.2.5 const CImgList<T>& display (CImgDisplay & *disp*, const char *axe* = 'x', const char *align* = 'c') const

Display the current **CImgList** (p. 145) instance in an existing **CImgDisplay** (p. 135) window (by reference).

This function displays the list images of the current **CImgList** (p. 145) instance into an existing **CImgDisplay** (p. 135) window. Images of the list are concatenated in a single temporarly image for visualization purposes. The function returns immediately.

Parameters:

disp : reference to an existing **CImgDisplay** (p. 135) instance, where the current image list will be displayed.

axe : specify the axe for image concatenation. Can be 'x','y','z' or 'v'.

align : specify the alignment for image concatenation. Can be 'p' (top), 'c' (center) or 'n' (bottom).

Returns:

A reference to the current **CImgList** (p. 145) instance is returned.

4.4.2.6 const CImgList<T>& display (const char * *title*, const char *axe* = 'x', const char *align* = 'c', const int *min_size* = 128, const int *max_size* = 1024, const int *print_flag* = 1) const

Display the current **CImgList** (p. 145) instance in a new display window.

This function opens a new window with a specific title and displays the list images of the current **CImgList** (p. 145) instance into it. Images of the list are concatenated in a single temporarly image for visualization purposes. The function returns when a key is pressed or the display window is closed by the user.

Parameters:

title : specify the title of the opening display window.

axe : specify the axe for image concatenation. Can be 'x','y','z' or 'v'.

align : specify the alignment for image concatenation. Can be 'p' (top), 'c' (center) or 'n' (bottom).

min_size : specify the minimum size of the opening display window. Images having dimensions below this size will be upscaled.

max_size : specify the maximum size of the opening display window. Images having dimensions above this size will be downscaled.

Returns:

A reference to the current **CImgList** (p. 145) instance is returned.

4.4.2.7 const CImgList<T>& display (const char *axe* = 'x', const char *align* = 'c', const int *min_size* = 128, const int *max_size* = 1024, const int *print_flag* = 1) const

Display the current **CImgList** (p. 145) instance in a new display window.

This function opens a new window and displays the list images of the current **CImgList** (p. 145) instance into it. Images of the list are concatenated in a single temporarly image for visualization purposes. The function returns when a key is pressed or the display window is closed by the user.

Parameters:

axe : specify the axe for image concatenation. Can be 'x','y','z' or 'v'.

align : specify the alignment for image concatenation. Can be 'p' (top), 'c' (center) or 'n' (bottom).

min_size : specify the minimum size of the opening display window. Images having dimensions below this size will be upscaled.

max_size : specify the maximum size of the opening display window. Images having dimensions above this size will be downscaled.

Returns:

A reference to the current **CImgList** (p. 145) instance is returned.

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