Brain tumor MRI synthesis using GAN aggregation
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Motivation

- MRI is a powerful non-invasive tool for obtaining location and growth of tumor.
- Lack of medical imaging data along with high class imbalance due to resource constraints and privacy concerns.
- Traditional data augmentation generates highly correlated images with less variance resulting in poor generalization.
- Generative Adversarial Networks (GAN) have shown promising results with good generalization on a large variety of images. It serves as an anonymization tool and reduces data handling risks.
- We evaluate 5 GAN models individually, then run an aggregation algorithm followed by style transfer.
- This allows our model to capture both the unique and shared features in the latent representation. Style transfer allows us to capture localized information.
- We aim to perform an ablation study to measure contribution of fake images produced by the Aggregate GAN (AGGrGAN) model [1] to a basic classification network.

New Technique

- We added a UNet-GAN whose discriminator is a UNet. A UNet discriminator provides region-specific feedback to the generator for improved image synthesis.
- UNet-GAN was added to the aggregation process of AGGrGAN in addition to DCGAN and WGAN.
- We also enhanced the aggregation logic to process all images instead of top 3 images based on PSNR/SSIM metric.
- We performed style transfer using three intermediate layers of VGG-19 and then used Adam optimizer on content + style loss.
- Flow chart of AGGrGAN model.

Experimental Results

We present the images from individual GANs and the AGGrGAN followed by the PSNR and SSIM scores of both T1 and T1ce modalities from the BraTS 2020 dataset.

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Real     DC GAN  W GAN-GP U NET GAN  AGG GAN
T1
T1ce
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Ablation study of GANS and style transfer.

Training progress of DCGAN.

Model losses decrease rapidly initially leading to a steady mean with high variance. PSNR increases rapidly followed by a steady increase.

References

[1] Mukherjee et al., Brain tumor image generation using aggregation of GAN, Scientific Reports, 2022