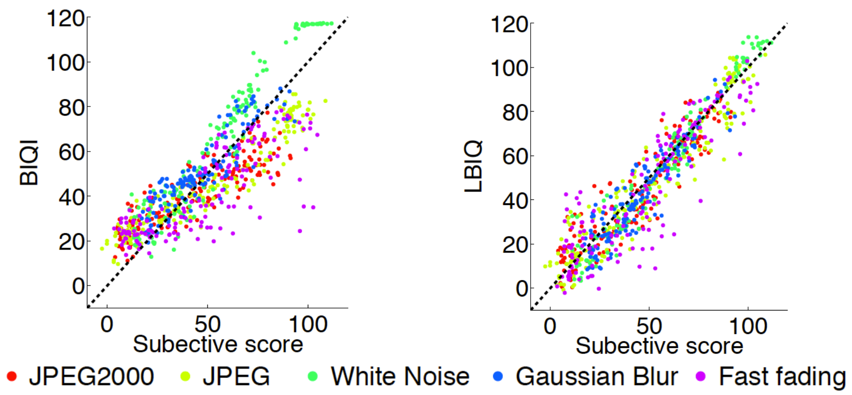
Learning a Blind Measure of Perceptual Image Quality

Huixuan Tang* Neel Joshi† Ashish Kapoor†

***University of Toronto †Microsoft Research**

Motivation

- Provide a measure of image quality as perceived by a human observer:
  - Assessment does not require knowing the ground-truth image or degradation process.
  - The score it provides is consistent across images and types of degradation processes.

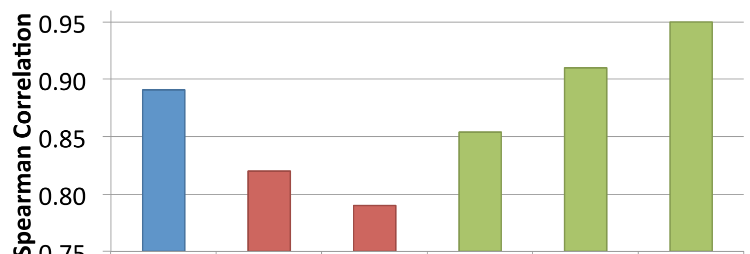


Challenges

- Direct noise measures do not map well with perceptual quality.
- The reference image and distortion type are unknown and estimating them can be difficult.
- Different types of image degradation processes affect an image's structure and statistics in a variety of ways.

Contributions

- Several novel low-level features for measuring image quality.
- An algorithm to combine these features in order to learn a perceptually relevant image quality measure.
- Our LBIQ measure significantly outperforms state of art blind image quality assessment methods.

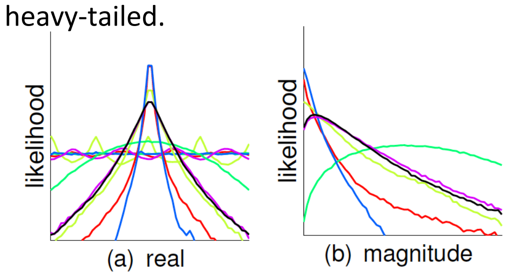


	LBIQ	BIQI	BLIIND	PNSR	SSIM	VIF
Overall	0.89	0.82	0.79	0.85	0.91	0.95

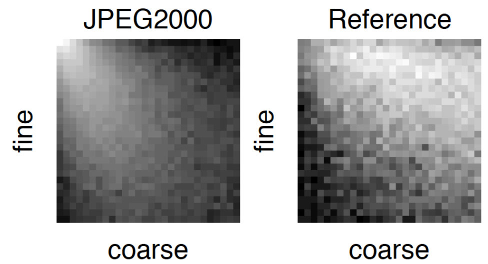
Designing Image Quality Features

Natural image statistics

- High frequency responses of natural images are often zero-peaked and heavy-tailed.

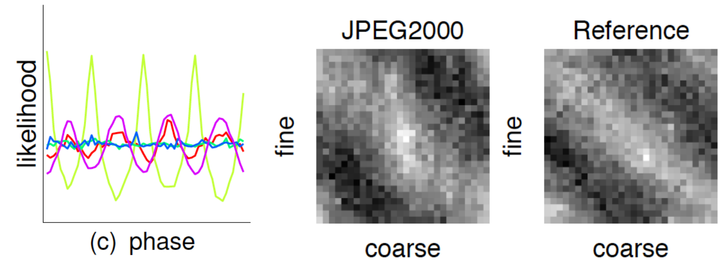


- High quality images often show self-similarity across scales.



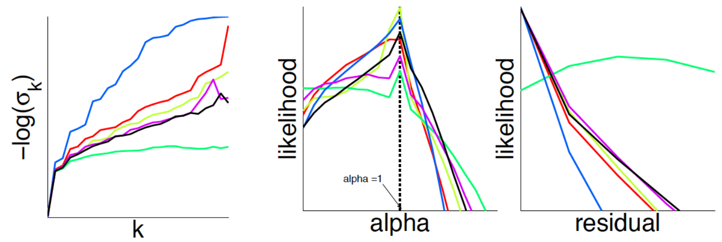
Texture of degradation artifacts

- Phase statistics are a good indicator of distortion artifacts.

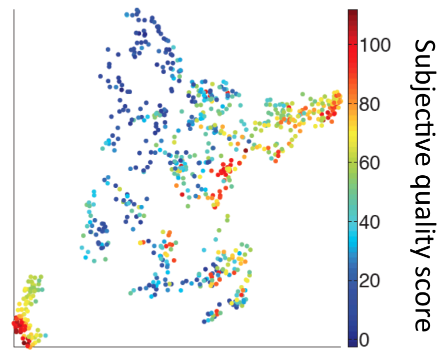


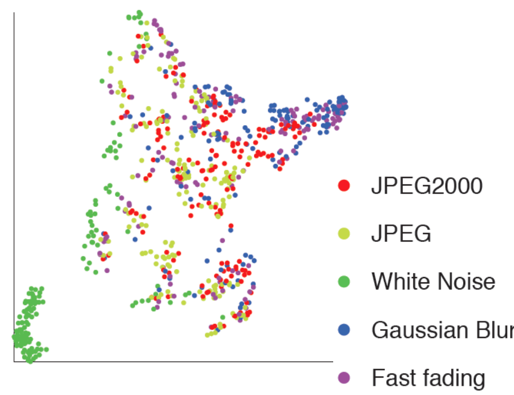
Blur/noise statistics

- Noise and blur are two fundamental degradation processes that occur in a variety of distortion types, and they can be directly measured.



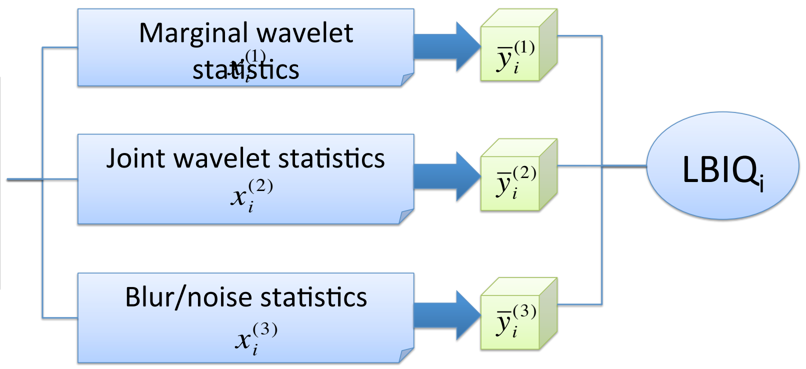
t-SNE embedding of image features





Learning Framework

i-th image



$$w^{(j)} = \arg\min_{w} \tfrac{1}{2}\|w\|^2 + C\sum_i \xi_i + C\sum_i \xi_i^*$$

$$\text{s.t. } -\varepsilon - \xi_i^* \le \bar{y}_i^{(j)} - y_i \le \varepsilon + \xi_i, \quad \xi_i \ge 0, \xi_i^* \ge 0.$$

$$\bar{y}_i^{(j)} = \sum_n w_n^{(j)} k(x_i^{(j)}, x_n^{(j)}) + b^{(j)}$$

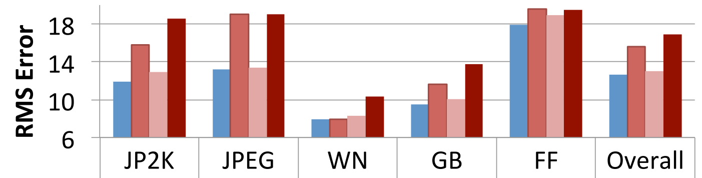
ε-SVR

$$\mu^* = \arg\min_{\mu} \sum_i (LBIQ_i - y_i)^2$$

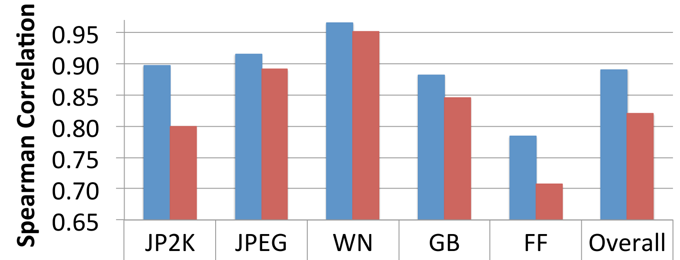
$$LBIQ_i = \sum_j \mu_j^* \bar{y}_i^{(j)}$$

Linear Regression

Performance



	JP2K	JPEG	WN	GB	FF	Overall
LBIQ	11.93	13.17	7.91	9.51	17.95	12.65
M1	15.81	19.01	7.89	11.65	19.60	15.60
M2	12.88	13.35	8.29	10.03	18.94	13.00
M3	18.58	19.04	10.32	13.80	19.51	16.92



	JP2K	JPEG	WN	GB	FF	Overall
LBIQ	0.90	0.92	0.97	0.88	0.78	0.89
BIQI	0.80	0.89	0.95	0.85	0.71	0.82