



Blind Measurement of Blocking Artifact in Images

Zhou Wang

Lab for Image and Video Engineering

Dept. of Electrical and Computer Engineering

The University of Texas at Austin

Blocking Effect



- ▶ Most image/video coding standards use DCT
- ▶ Quantization is used to achieve low bit rates
- ▶ Decoding is lossy
- ▶ Coding artifacts including blocking, blurring, and ringing, etc.
- ▶ Blocking effect is usually the most significant

Blocking Effect Measurement

✓ Applications

- ▶ Encoder - optimize parameter selection and bit allocation
- ▶ Decoder - design post-processing algorithm

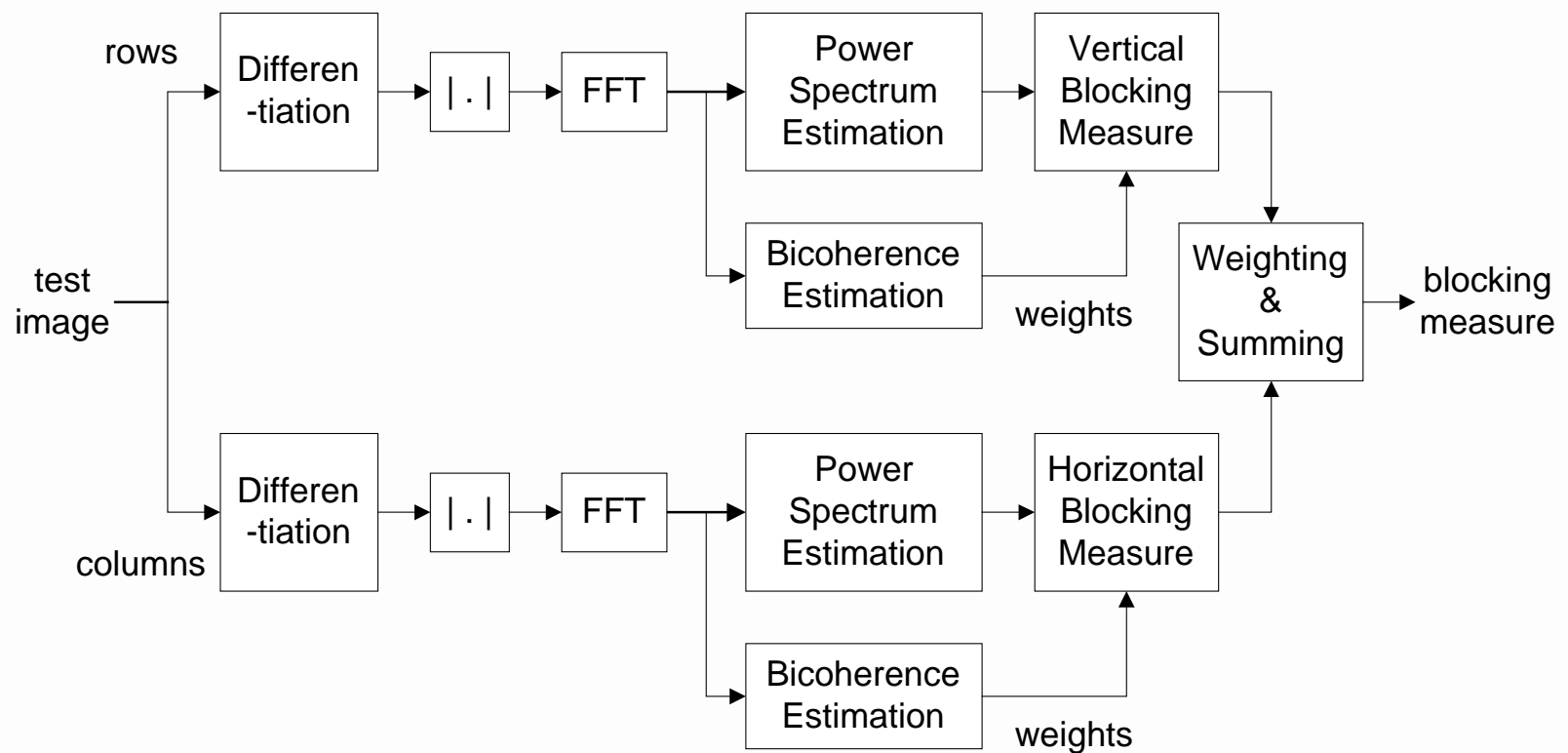
✓ Measurement Methods

- ▶ Raw numerical errors - Mean Squared Error (MSE)
- ▶ Human Visual System (HVS) based metrics

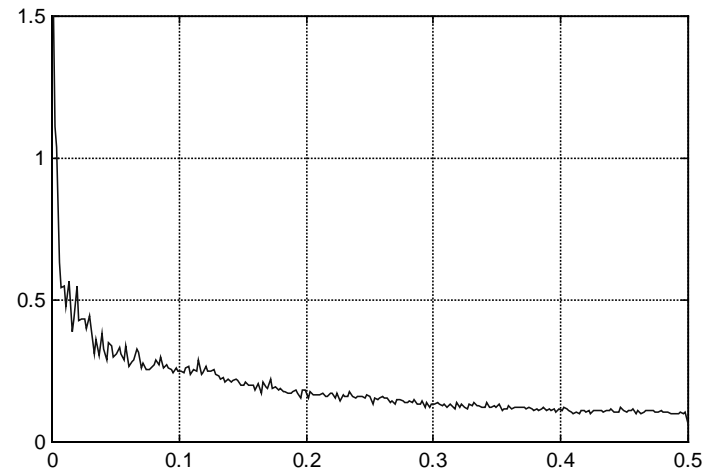
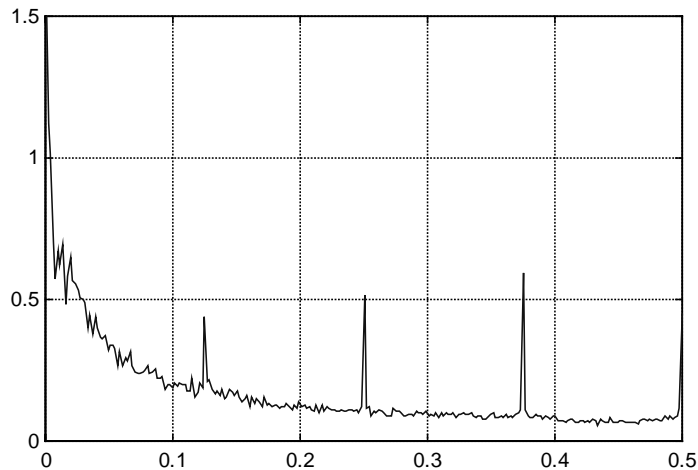
✓ Blind Measurement

- ▶ Original reference images are not available

Proposed Measurement System

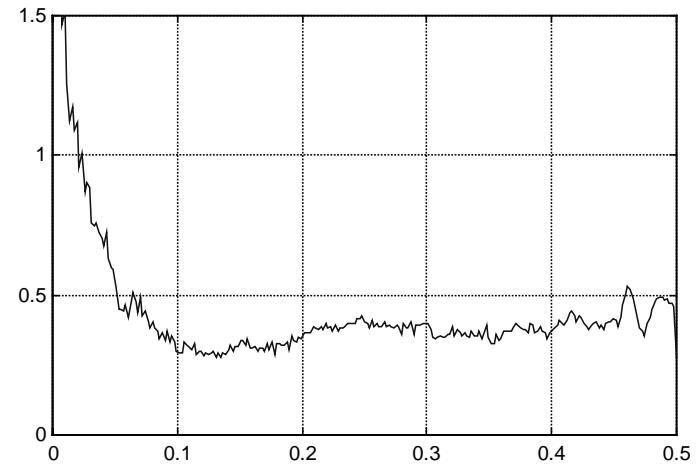
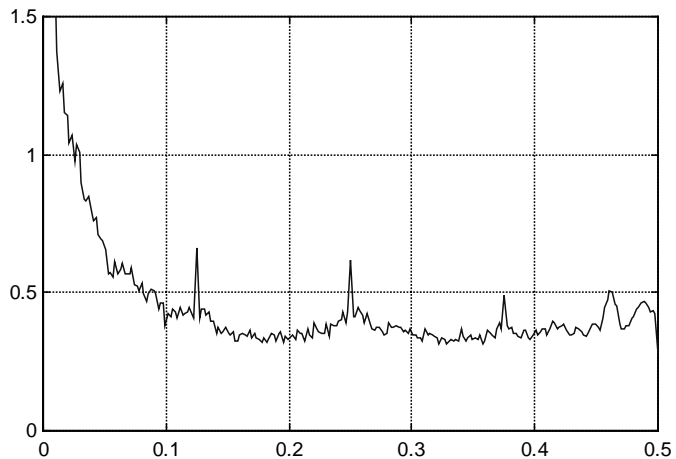


Power Spectrum



- ✓ Comparison of power spectra of the blocky and the original images
- ✓ The blockiness is characterized by the peaks at several feature frequencies

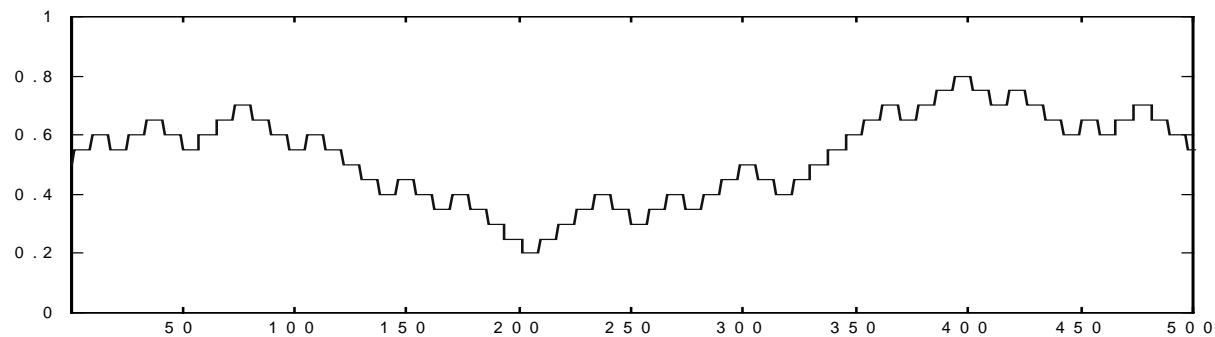
Power Spectrum (continued)



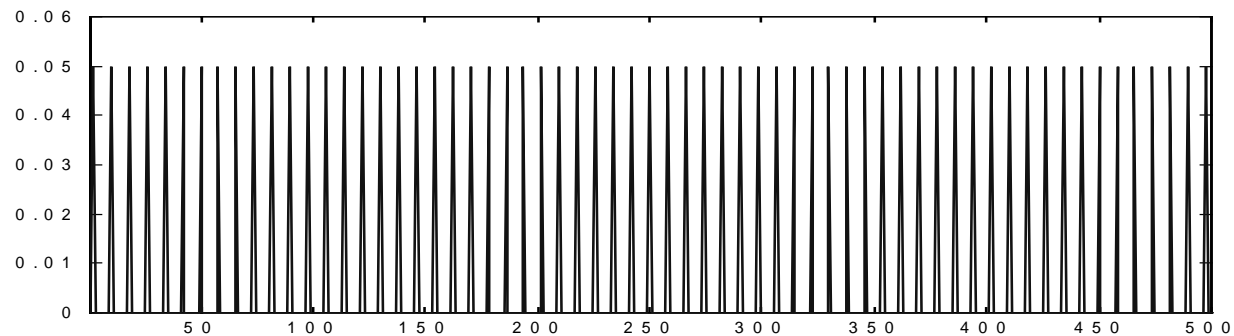
- ✓ In some cases, the image signal itself has a special frequency distribution that may disturb the characteristic frequency components.
- ✓ Difficult to get a robust measure on power spectrum

Ideal 1-D 'blocky' signal

- ✓ 1-D blocky signal

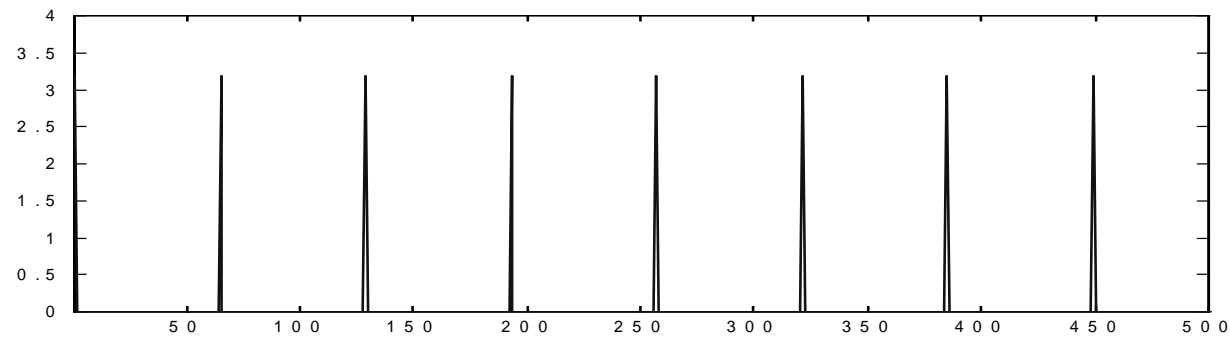


- ✓ Being differentiated and applied absolute operator

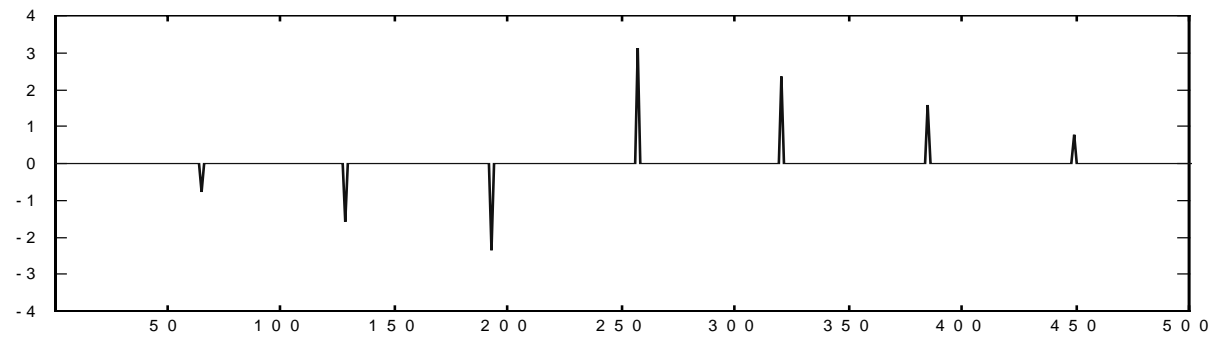


Idea 1-D 'blocky' signal (cont.)

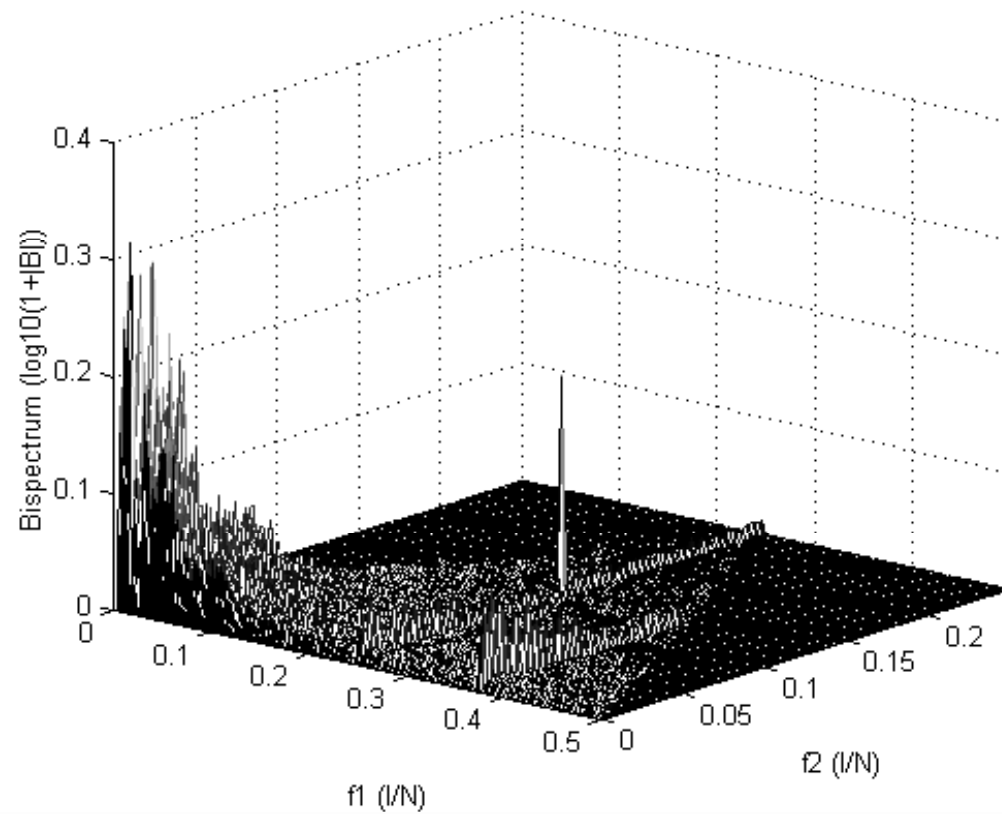
✓ Magnitude of FFT result



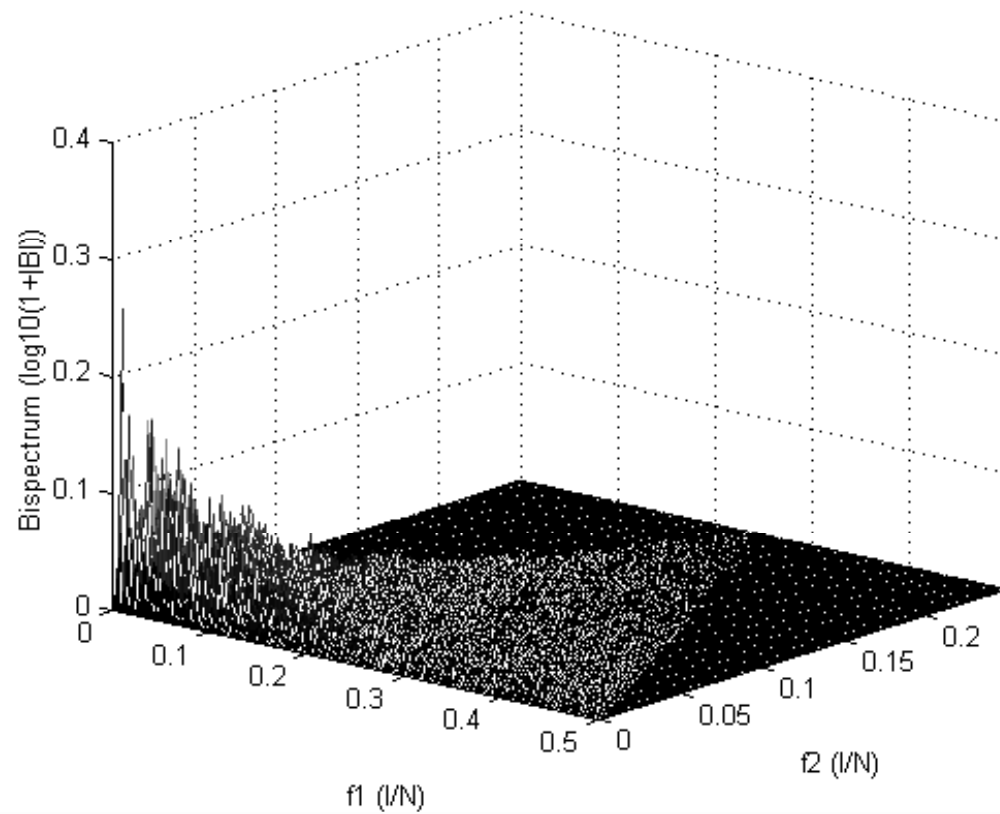
✓ Phase of FFT result



Bispectrum - Blocky Image



Bispectrum - Original Image



Blocking Metric

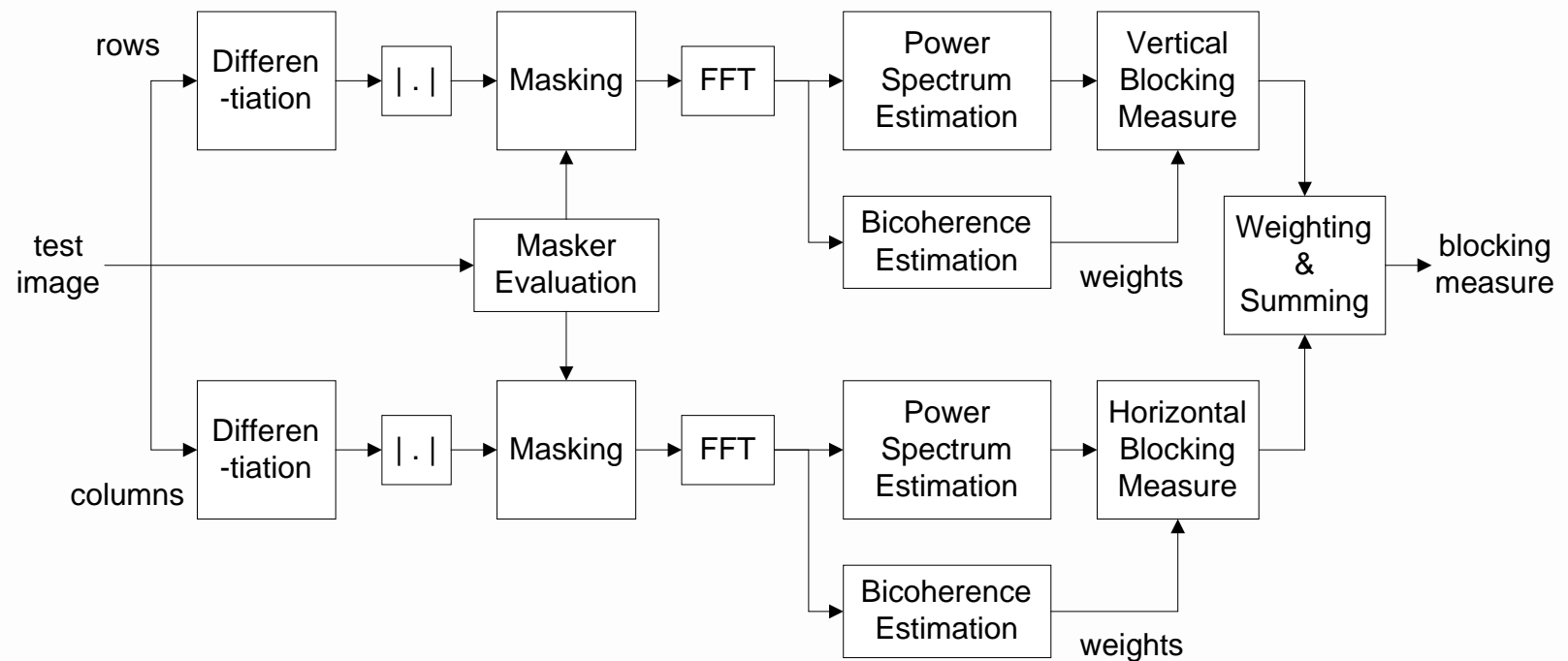
✓ Vertical Blocking Metric

$$M_{Bv} = C \cdot \gamma_{xxx}^2 [N/8, N/4] \cdot (P[N/8] + P[N/4] + P[3N/8])$$

✓ Overall Blocking Metric

$$M_B = 0.5M_{Bv} + 0.5M_{Bh}$$

Modified Measurement System



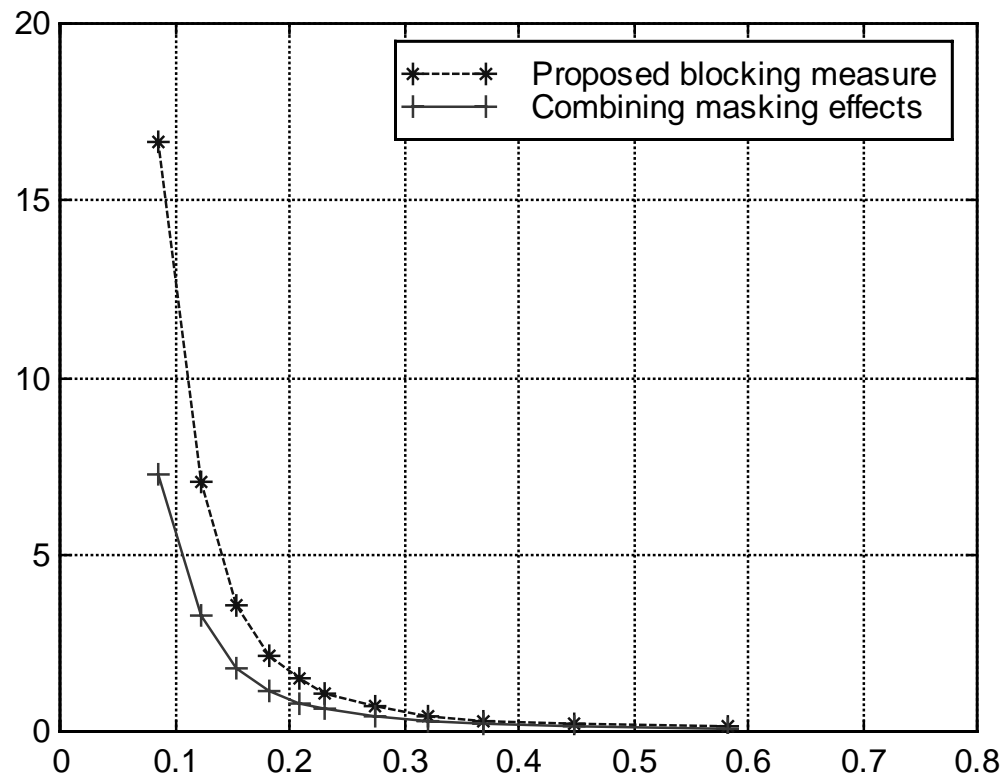
Masker Evaluation



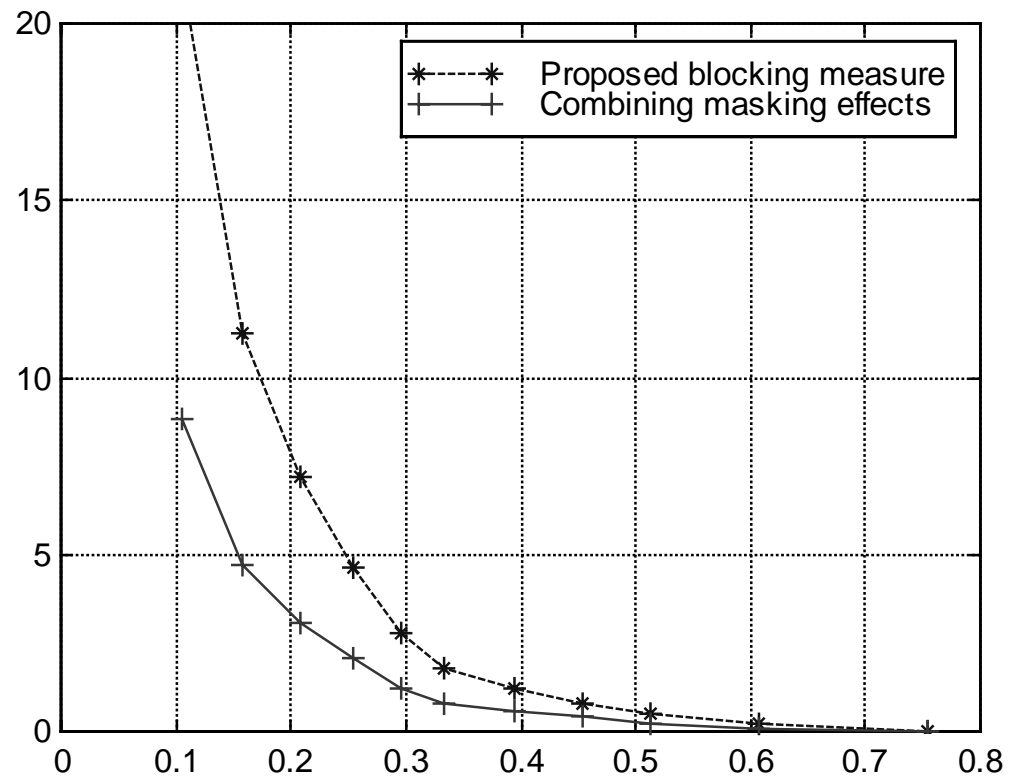
- ✓ Luminance masking
 - ▶ more sensitive to mid-level errors
- ✓ Local activity masking
 - ▶ more sensitive to errors in smooth areas

- ← Brighter - stronger masker
- ← Darker - weaker masker

Measurement Results - 'Lena'



Measurement Results - 'Barbara'



Conclusions - What has been done?

- ✓ A new blind blocking artifact measurement system is developed. This method is deterministic. No parameter needs to be pre-defined.
- ✓ A modified version of the measurement system has also been developed, which combines human visual masking effects.

Conclusions - What's new?

- ✓ The new measurement systems can be applied blindly, while most of the other image quality measures need the reference images.
- ✓ The new algorithms employ higher order statistics (HOS) features. It is a new application of HOS technique in the field of image processing.

Conclusions - What's new? (cont.)

- ✓ Several statistical features of the image signals (power spectrum, bispectrum, biconherence) have found to be related to blocking effect.
- ✓ The most interesting feature is the bispectrum, which may be viewed as a signature of blockiness.