DCT-Domain Blind Measurement of Blocking Artifacts

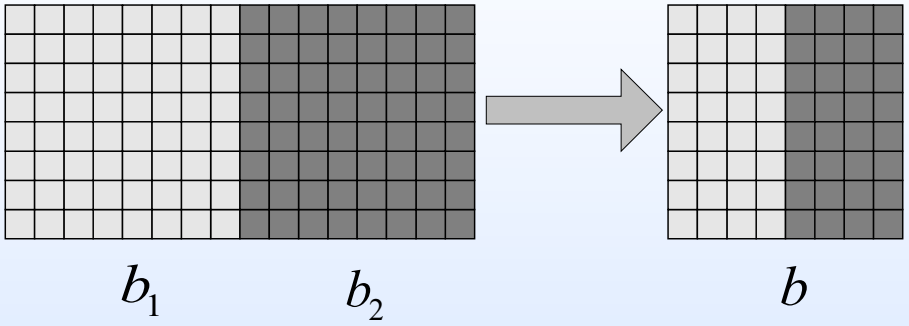
- **Model Blocking Artifacts as a 2-D Step Function in *b***

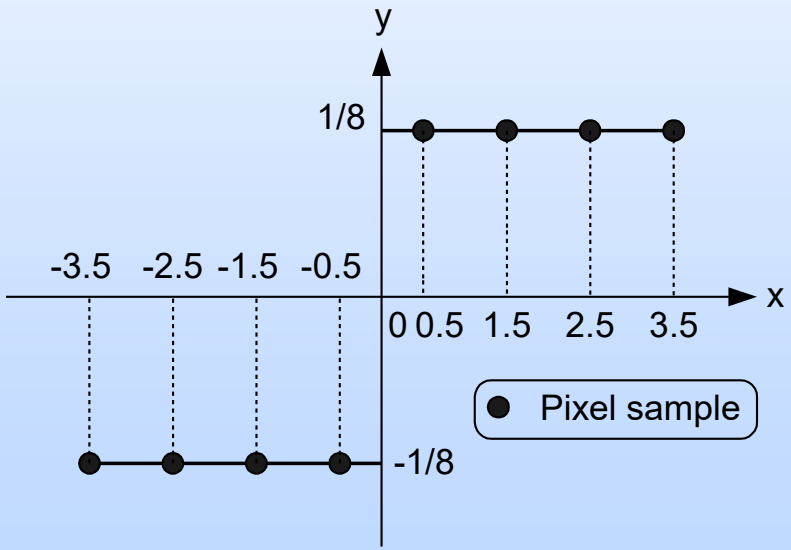
$$b = \beta \cdot s + \mu + \gamma$$

β : the magnitude of S

μ : the background luminance

γ : the activity inside b

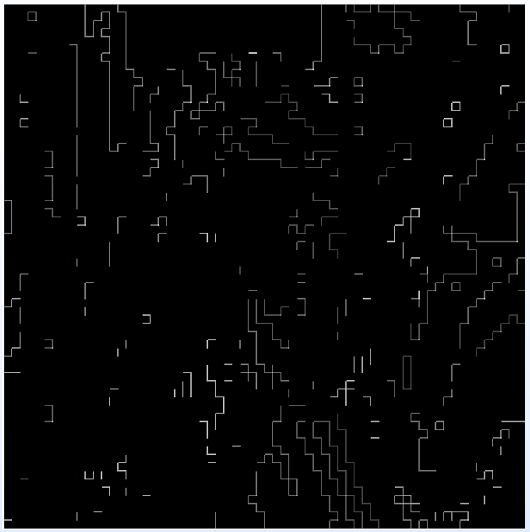




Side view of the 2-D step function S

- **Parameters are Computed in the DCT Domain**
- **HVS Based Measurement**
  - Activity masking
  - Luminance masking

Experimental Results



Lena JPEG-coded at 0.22 bits/pixel

Lena JPEG-coded at 1 bits/pixel

Experimental Results *cont.*

- **Global Measure of Blocking Artifacts**

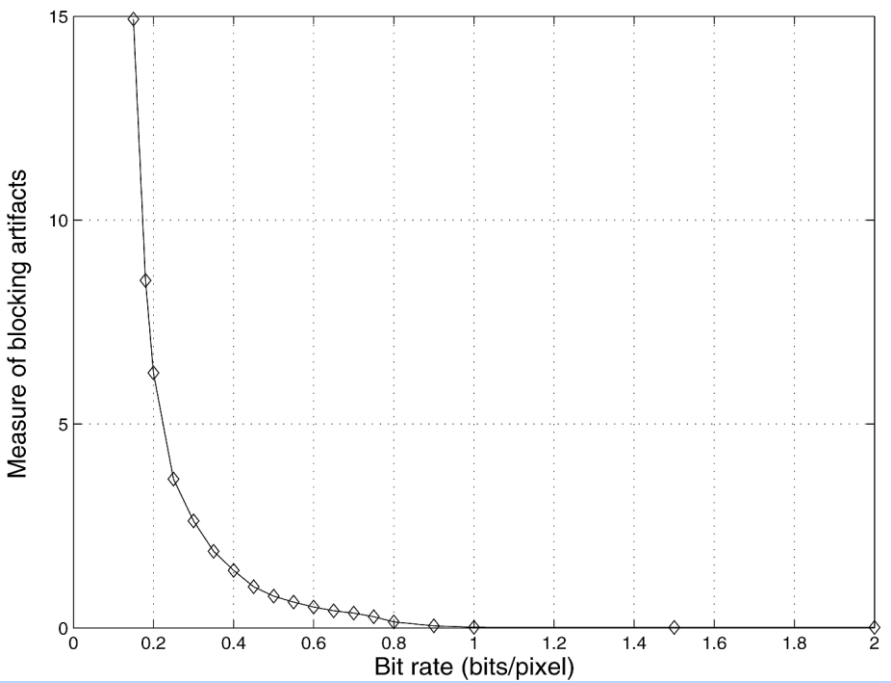
$$\Theta = \sqrt[p]{\frac{1}{N}\sum_{k=1}^{N}\eta_k^p}, \qquad p = 4$$ [Coudoux, Gzalet & Corlay 98]

N : the total number of inter-block boundaries.

η_k : local measure of blocking artifact at each inter-block boundary

k : # of block boundary

- **Consistent with Other Methods** [Wang , Evans & Bovik, 00], [Coudoux, Gzalet & Corlay 98]



S. Liu, and A. C. Bovik, "*DCT-Domain Blind Measurement of Blocking Artifacts in DCT-coded Images* ", ICASSP 2001.

DCT-Domain Reduction of Blocking Artifacts

- **Edge Detection in the DC Image**
  - Sobel gradient operator

- **All Block Boundaries are Divided into Three Categories**
  - Type I: $\eta < \tau$
  - Type II: $\eta \geq \tau$ and neither of the two adjacent blocks is *edge block*
  - Type III: $\eta \geq \tau$ and at least one of the two adjacent blocks is *edge block*

η : measured visibility of blocking artifact

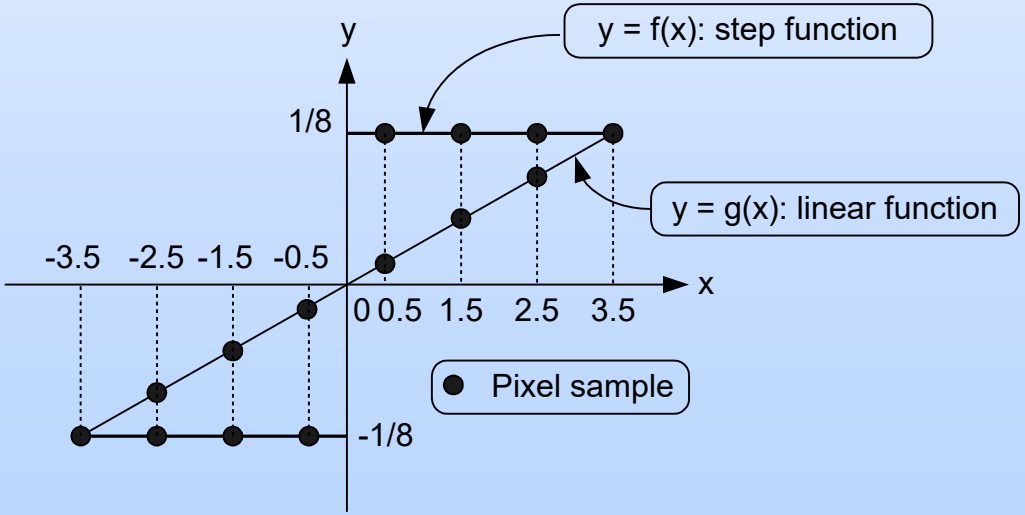
τ : threshold of visible blocking artifacts $\tau = 0.02$

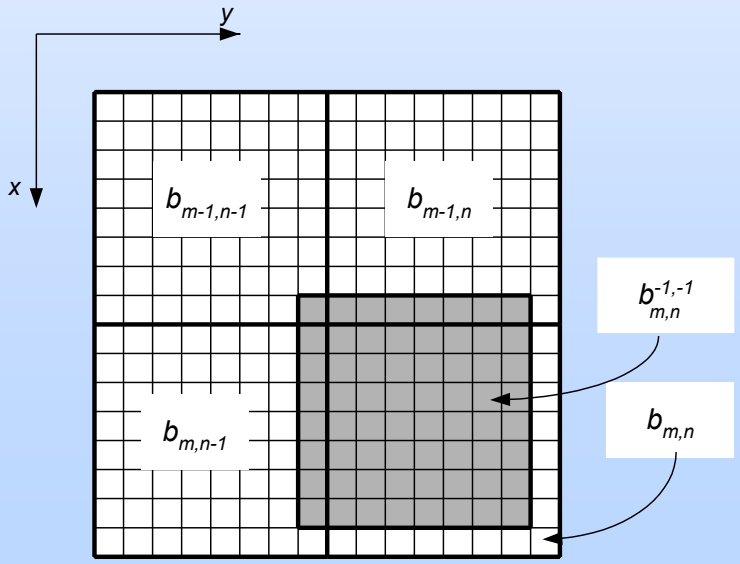
Edge block: block on the detected edges

DCT-Domain Reduction of Blocking Artifacts *cont.*

- **No Process for Type I Block Boundaries**
- **Replace the 2-D Step Function with a 2-D Linear Function for Type II Block Boundaries**
- **Post-filtering Type II and Type III Block Boundaries in the DCT Domain**

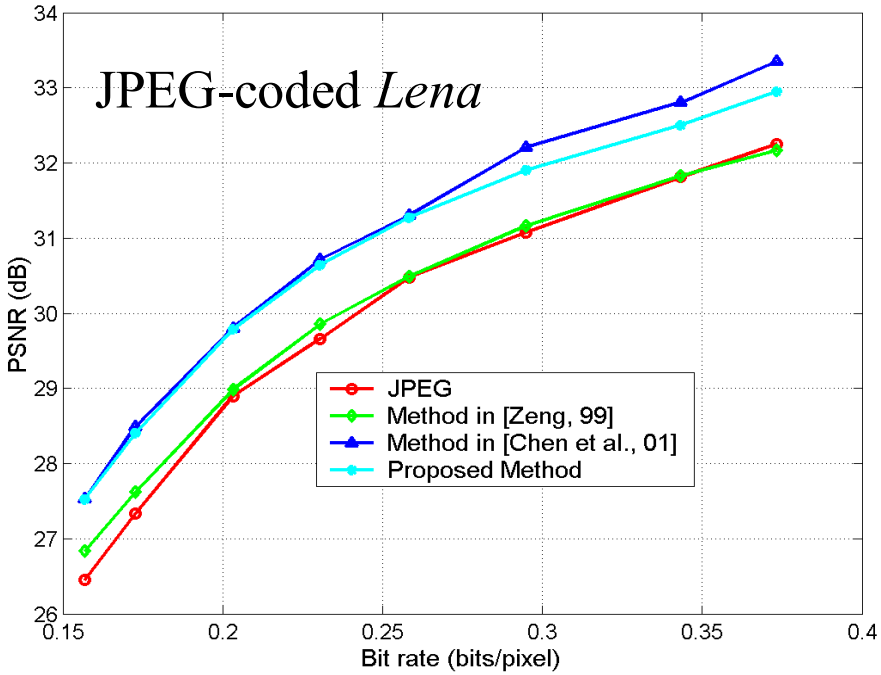
$$B_{m,n}(u,v) = \frac{1}{W}\sum_{k=-1}^{1}\sum_{l=-1}^{1} w_{k,l} B_{m,n}^{k,l}(u,v), \quad W = \sum_{k=-1}^{1}\sum_{k=-1}^{1} w_{k,l}, \quad w_{k,l} = \begin{cases} 3 & \text{for (k,l)=(0,0)} \\ 1 & \text{otherwise} \end{cases}$$





Performance and Comparison

- **The Proposed Method Has Good Performance**
  - Improves image visual quality significantly
  - Low computational cost, less than 30% of the method proposed in [Chen, Wu & Qiu 01]



S. Liu, and A. C. Bovik, "*Efficient DCT-Domain Blind Measurement and Reduction of Blocking Artifacts* ", IEEE Trans. On Circuits and Systems for Video Technology, submitted

Decoded Image

DCT-domain zeroing method [zeng, 99]

DCT-domain postfiltering [chen et al, 01]

Proposed method