JPEG 2000 Implementation Guide

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Why Have an Implementation Guide?

- With all of the details in the JPEG 2000 standard (ISO/IEC 15444-1), it is still incomplete.
- Why?
  - The standard describes a *decoder*
  - It makes non-normative remarks regarding encoders
  - Implementer is left to fill in the blanks
  - Standards are notoriously short on examples
  - Things are not always as clear as we would like
- Implementation Guide was created to address these issues
    - This is the protected area of the NTB website
    - For access look at [http://164.214.2.51/ntb/baseline/toc.html](http://164.214.2.51/ntb/baseline/toc.html)
  - Even though it’s a working draft, it’s a very good document
Areas Where the Guide Helps

• Further/alternate explanation of the JPEG 2000 standard
  – Packets headers and tag trees
• Examples to illustrate various processes in JPEG 2000
• Things you need to know to make an encoder
  – Rate and distortion estimation procedures for rate control
  – Layer formation
  – Computation of 9-7I wavelet subband energy weights
  – Design of quantization factors for 9-7I wavelet
  – Application of human visual weights to quantization
• In the future we plan to include coding improvements for specific data types
Guide Highlights

• Sections 2.1 and 2.2
  – Give overview of the JPEG 2000 processing flow
  – Introduction to JPEG 2000 nomenclature and constructs
    • Tiles, Reference grid, Resolution and decomposition levels
    • Code blocks, Precincts, Packets, Layers and coding passes

• Section 2.3
  – Describes major processing sections in JPEG 2000
  – High level image and tile processing procedures
  – Reference grid equations and interrelationship between
    • Image and tile size/offsets
    • Resolution levels and wavelet subbands
    • Component subsampling
    • Computing the size of a tile-component
    • Computing the number of pixels/coefficients
Guide Highlights

• Section 2.3 (continued)
  – Wavelet transform processing
    • Mechanics of lifting with examples
      – Signal flow graphs
      – Interleave and de-interleave procedures
    • Determining convolution equivalent wavelet synthesis filters (9-7I)
      – Used in design of quantization factors for 9-7I wavelet
    • Small tiles with vanishing dimension in wavelet decompositions
      – Leads to empty or one dimensional subbands
  – Quantization
    • Explicit quantization of 9-7I wavelet coefficients
      – Forward and inverse quantization procedures
      – Inverse quantization when all bitplanes have not been received
    • Implicit quantization of 5-3R wavelet coefficients
      – Forward and inverse quantization procedures
      – Inverse quantization when all bitplanes have not been received
Guide Highlights

• **Section 2.3 (continued)**
  
  – **Quantization (continued)**
    
    • **“Base step size” quantization for 9-7I wavelet**
      
      – Design technique that takes single quantization step and tailors it individually for each wavelet subband
      
      – Computation of energy weights
        
        • Needed for base step size design
        
        • Based on convolution equivalent wavelet synthesis filters
        
        • Determination of energy weights in the presence of small tiles (update coming for section)
      
      – Modification of procedure when using HVS weights
    
    – **Arithmetic entropy coder**
      
      • Various coding passes
      
      • Derivation of contexts
      
      • Different modes
Guide Highlights

- Section 2.3 (continued)
  - Rate-distortion estimation
    - Necessary for proper layering
    - Rate estimation
      - More accurate method to compute number of bytes out of arithmetic coder when truncating at the end of a coding pass
    - Distortion estimation
    - Binary search layer formation algorithm
  - Better explanation of packet headers and tag trees
    - Pseudo code and examples
Summary

• Implementation guide is a companion to the standard
  – Tried to make the more difficult sections easier to understand
  – Best to have both on hand
  – Will continue to update the guide

• If you need further help