Outline

• Background
• iCAM
• DV Extension
Image Colorimetry

- Device Dependent
- Device Independent
- Viewing-Conditions Independent
Color Appearance

- Viewing-Conditions Independent
- Spatially Localized
Image Appearance & Quality

- IQ (Thresholds & Magnitudes)
- Combine with Color Appearance

- Get “Image Appearance”
Moving Image
Appearance & Quality

• Temporal Adaptation & Filtering
The iCAM Framework
Image
Appearance
Applications
(Rendering)
Gaussian Low-Pass
2-sigma = 1/4 Image Width
~4 Degrees

INVERSE FOR DISPLAY

IPT to RGB
(fixed exponent)

RGB to XYZ
(fixed adaptation)

XYZ to Display RGB
(characterization)

CIECAM02 $F_L$ Function
Norm. to 1.0 at 1000 cd/m²
Clipped to Min. of 0.3
Multiplied by IPT Exp. (0.43)
Image Quality Applications (Difference Perceptibility)
RGB to IPT (linear)

Spatial Filtering

Localization & Local Contrast

IPT (linear) to RGB

Power Functions

RGB (nonlinear) to IPT

\[ \Delta I \quad \Delta P \quad \Delta T \]

\[ \Delta I_m = \text{Euclidean Sum} \]

Statistics: Mean, Median, Percentiles, Variance, etc.
Image Rendering Examples

<www.debevec.org>
Digital Video Rendering
Temporal Integrator
Based on Previous 10 Sec.
Psychophysically Derived

Gaussian Low Pass
2-sigma = 1/4 Image Width
~4 Degrees

Luminance Adaptation
Only

INVERSE FOR DISPLAY
IPT to RGB
(fixed exponent)
RGB to XYZ
(fixed adaptation)
XYZ to Display RGB
(characterization)

CIECAM02 $F_L$ Function
Norm. to 1.0 at 1000 cd/m²
Clipped to Min. of 0.3
Multiplied by IPT Exp. (0.43)

Rendered frame-by-frame with temporally integrated adaptation stimulus.
Temporal Integrator

Adaptation Weight

Time (in frames @ 30fps)

Fairchild & Reniff (1995)
Example Frames

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Example Video Sequence
Conclusions

• **Ingredients**
  - Color Appearance Model
  - Spatial Adaptation & Filtering Models
  - Temporal Adaptation & Filtering Models
  - Image Difference Metrics

• **Results**
  - Still & Video Rendering Algorithms
  - Still & Video Quality Metrics
Thank You.

Fuji, Kodak, IBM

<www.cis.rit.edu/mcsI/iCAM>