



INCITS W1.1
Color Rendition
Ad Hoc Group Report

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Ad Hoc Group Members

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The Problem

- Working to create a standard for evaluating color rendition of hard copy output generated from digital input
- What does it mean for the color to “look right” and how can the ability of any given printer to properly render color be measured?



Previous Progress

- Stated global decisions and assumptions with respect to color rendition
- Identified three unique sub-attributes to describe color rendition
- Developed visual definitions of these attributes
 - posted on website -- NCITS W1.1 2001 - 058
- Adopted the strategy of developing test targets and methods of quantifying the perceived sub-attributes.
 - difficult to have meaningful discussions without the presence of actual targets and data on which to base our discussions
- Elected to consider the color quantization sub-attribute first



Color Fidelity Sub-attribute

- Color Fidelity Definition
 - the ability to match colors where needed
 - colors look correct
 - does not require matching to an original or target print but can include matching to target colors.
- Examples of Color Fidelity Appearance in Images
 - image looks natural, color rendition meets expectations
 - skin tones, grass, sky look realistic
 - image is not too saturated or too washed out or too dark, etc.
 - color matches a target image when needed



Color Scale Sub-attribute

- Color Scale Definition
 - the ability to distinguish colors where needed
 - colors that should be perceived as separate are distinguishable
- Examples of Color Scale Appearance in Images
 - distinguish between dark colors to avoid blocked shadows
 - distinguish between light or pale colors to avoid blown highlights
 - adequate separation of colors to provide contrast in pictorial images and colors that are perceptually distinguishable in graphics.
 - are there enough colors and are they distinct where they should be?
 - contrast, color saturation, tonal detail in light and dark colors, detail in saturated colors, ability to distinguish hues



Color Quantization Sub-attribute

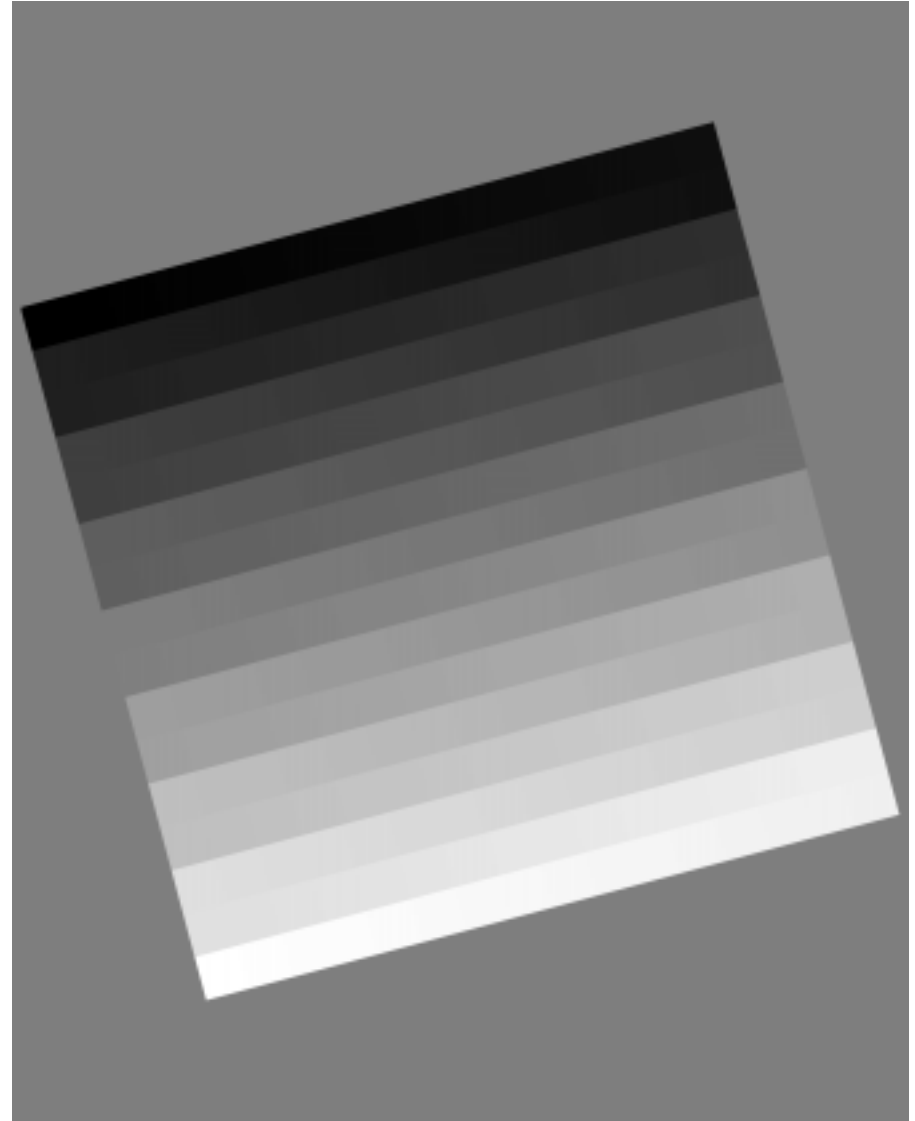
- Color Quantization Definition
 - the ability to merge colors where needed
 - colors that should be perceived as smoothly varying are free of contouring
- Examples of Color Quantization Appearance in Images
 - freedom from contouring in smooth sweeps (human faces, sky, differentially lit backgrounds, walls, etc. in pictorial images or vignettes, fades, or gradated backgrounds, etc. in graphical images)



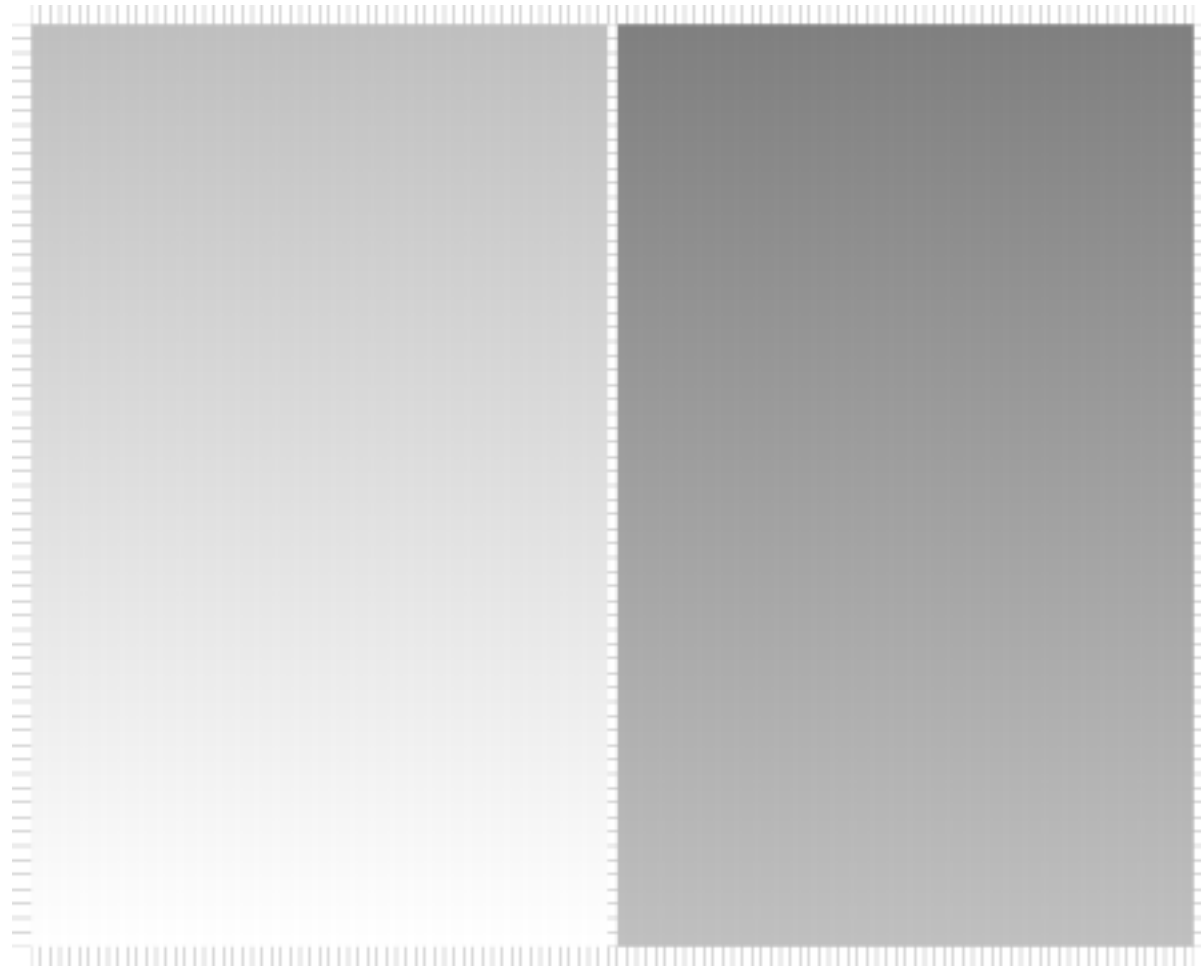
Current Activities

- Exploring possible test target configurations for detecting color quantization effects
 - color sweeps from white to the gamut boundary to black
 - serpentine test target
 - precision tone reproduction
- Currently evaluating scans of versions of these targets rendered on photographic, inkjet, and electrophotographic printers
 - correlating the visibility of contours with density measurements of the test targets

Serpentine Test Target



Precision Tone Reproduction Test Target





Future Work

- Continue to investigate color quantization test targets with the goal of developing an objective metric for quantifying color quantization
- Select either the color scale or color fidelity sub-attribute and begin work to define appropriate test targets
- Determine if there is fundamental research required for the remaining sub-attributes and plan and initiate this research, if needed
- Begin to collect and evaluate images on a perceptual basis while correlating these metrics to the perceptual judgments



Global Decisions wrt Color Rendition

- Effective Tone scale must be considered as a part of the color rendition attribute
- Variations in color rendition across in an image where a constant code value is specified is a macro-uniformity issue
- The printer is defined as “everything that happens after the print button is hit”
- Different metrics may be necessary for natural images and vector graphic images because of adaptation effects