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TITLE: Detection and Discrimination of Blur in Edges and Lines

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ABSTRACT

The results of psychophysical experiments are one key source of knowledge about Human Visual System properties. This contribution briefly summarizes one such experiment to determine observer sensitivity to blur in edges and lines. It finds that human discrimination between different levels of blur is more acute than between blurred and non-blurred features.

* Contact persons - Charles A. Dvorak Tel.: +1 908 580 6418, Fax -6881
E-Mail: cdvorak@att.com

Alfred C. Morton Tel.: +1 732 949 2499, Fax -1652
E-Mail: acmorton@att.com

Several recent contributions to Question 11 and VQEG describe objective video quality assessment methods that model properties of the human visual system (HVS). The results of psychophysical experiments are one key source of knowledge about HVS properties.

This referenced paper by Hamerly and Dvorak describes one such experiment to determine observer sensitivity to blur in edges and lines. They used a forced choice method where the task was to select the less blurred stimulus of a pair. The experimental apparatus automatically varied the transition width in response to subject response. Variables included three different blur profiles that define the transition between luminance minimum and maximum, and different luminance ratios (low luminance ratio means a high contrast edge or line).

The accompanying Figure shows the principal result of the study. The graphs are plots of the just-noticeable differences of line blur for the two subjects at two luminance ratios. The Just Noticeable Differences (JND) are largest for unblurred lines and decrease rapidly once the line is blurred. The finding was similar for edges.

Hamerly and Dvorak concluded that human discrimination between different levels of blur is more acute than between blurred and non-blurred features. This raises several points that are pertinent to video quality assessment specifications, including:

1. Different methods or models may be necessary for quantification of perceptible blur levels and sub-detection levels. Therefore, the blur detection threshold should be known.
2. This result helps explain why different video digital sampling format densities (e.g. ITU-R Rec 601, CIF, QCIF) with their inherent ability to render edges and lines may be easily distinguished at usual viewing distances.
3. Other spatial impairments may exhibit different detection and discrimination HVS sensitivities, and this would also influence the specification of performance assessment methods.

The acute HVS sensitivity to different levels of blur should be addressed in any method adopted under the video questions for both subjective and objective measurements.

REFERENCE

J. Hamerly and C. Dvorak, "Detection and Discrimination of Blur in Edges and Lines," Journal of the Optical Society of America, Vol. 17, pages 448-452, April 1981. (available at http://www.t1.org/index/0611.htm as document 7a151140.doc)

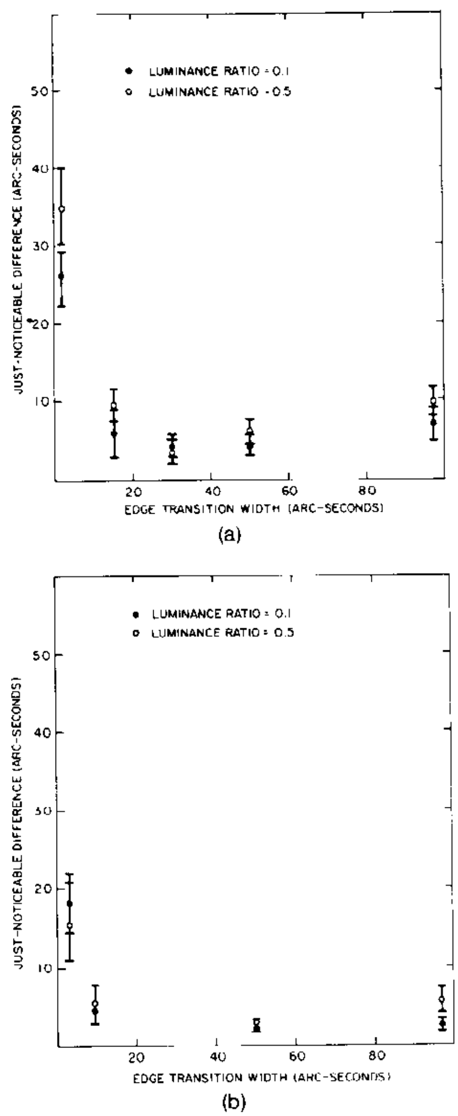

Figure 1. (a) Line-blur just-noticeable differences as a function of edge-transition width. Observer JH. Open circles represent a luminance ratio of 0.5, filled circles a luminance ratio of 0.1. Maximum luminance, 25.5 fl. (b) Line-blur just-noticeable differences as a function of edge transition width. Observer CD. Open circles represent a luminance ratio of 0.5, filled circles a luminance ratio of 0.1. Maximum luminance, 25.5 fl.