HUMAN vs. VISION MODEL PERFORMANCE FOR TWO MEDICAL IMAGE ESTIMATION TASKS

by

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ABSTRACT

A computed method for measuring medical image quality would allow fast and economical evaluation of image acquisition and display systems without the need for arduous, expensive human observer experiments. It would help such a method to be predictive of human assessment if it reflected the principles thought to govern the operation of the visual system. This dissertation research implemented and tested the accuracy of a measure of medical image quality that incorporates a model of human vision in a simulation of human image interpretation. It was hypothesized that the model, by performing in a way that reflected the inherent capabilities and limitations of a human, would be predictive of human performance as physical properties of the image varied. The core model of shape perception, a theory for the representation of objects that may serve as a fundamental perceptual basis for a number of medical image interpretation tasks, was applied in computing estimates of the depth of a vessel stenosis in an angiogram and the position of a radiation treatment field relative to the spinal cord in a portal image. Parameters of those imaging systems that have significant effects on the physical characteristics of the images, such as the amount of imaging system blur or the extent of contrast-enhancing processing, were systematically varied. Model and human task performance was studied as a function of the parameters in order to assess the extent to which the model predicted the human results. In most instances, the analysis suggested that the conformance of the model and human data was not sufficient to allow use of the visual model as proposed. The conclusion explores the potential factors in those discrepancies and reiterates the claim that image quality assessments based upon fundamental principles of visual perception might eventually be utilized successfully for medical image interpretation tasks.

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