Szczecin, 22.01.2020r.

DOCTORAL THESIS ABSTRACT

Measurement of contrast sensitivity characteristics in peripheral vision and its application in the acceleration of image synthesis

Author : mgr inż. Michał Chwesiuk

Supervisor: dr hab. inż. Radosław Mantiuk, prof. ZUT

Image synthesize computer algorithms are computationally expensive and require the significant computing power of processors. In real-time computer graphics, the time for the synthesis process is limited, which makes it crucial to use techniques that reduce the required computational cost. One of the ways to accelerate the synthesis of images is to use the features of the human visual system, which selectively interprets information about the observed scene. For example, you can skip the synthesis of the information that will not be seen by a human due to its limited sensitivity to contrast.

In this work, the contrast sensitivity of the human visual system was measured for achromatic, chromatic and mixed stimuli for central and peripheral vision. The measurement was made using a perceptual experiment in which the stimulus in the form of the Gabor pattern was presented to the observers. The innovative experiment methodology introduced the usage of an eye tracker to ensure that the required gaze direction was maintained correctly. The measurement results allowed to develop an analytical model describing the relationship between contrast sensitivity and viewing angle. To extend the state of the art such a model was proposed for chromatic stimuli. The measured contrast sensitivity was used in the image synthesis system that uses the ray tracing algorithm. The selective image sampling, in which the sampling frequency of the virtual scene depends on the gaze direction of the observer, reduced the number of traced rays and thus accelerated the image synthesis process. Another topic of the work was the experimental study of visual system latency in identifying high-frequency information during the change of vision from peripheral to central. The obtained results allow determining the required speed of rendering systems and visualization of images using eye trackers.

The doctoral thesis indicates the possibility of using the visual system feature, which is limited contrast sensitivity, to determine the boundaries of improving the parameters of rendering and image display systems.

23.01.2020 Michał Chwesiuk