ABSTRACT OF PhD THESIS

Perceptual methods of assessing the quality of images synthesized by computer game engines

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The main purpose of the work is to propose an automatic, objective method for assessing the quality of images generated by real-time game engines, that gives results most closely matching to the indications obtained from participants of perceptual experiments.
In terms of work, two image databases were prepared: the first one presenting artifacts commonly found in computer game images - aliasing, shadow acne, peter panning, Z-fighting and the second one, consisting of images from games rendered with different texture quality, shadow quality and anti-aliasing method. Each test image at both bases with an artifact or of reduced quality was accompanied by a reference image - rendered with the highest possible quality and without artifacts.

A series of perceptual experiments were performed using two different techniques (side-by-side and flickering) on both created image databases. Participants of the experiments were asked to paint local areas of images containing in their opinon an artifact or lower graphics quality in relation to the reference image. The reference maps of differences resulting from perceptual experiments were analyzed for agreement of the participants' paintings. Thanks to modeling the probability of detecting differences by the average observer, it was possible to determine which of the used perceptual experiment techniques gives more reliable and credible results.

The effectiveness of classic (not based on machine learning) image quality metrics - Mean Squared Error (MSE), Structural SIMilarity (SSIM), Multi Scale Structural SIMilarity (MS-SSIM), Color Image Difference (CID), S-CILEAB and High Dynamic Range - Visual Difference Predictor 2 (HDR-VDP-2), was evaluated by comparing the results of the metrics with those of the perceptual experiment. A technique, considered to be the best up to date image quality metric, based on the convolutional neural network, was also tested.

In the dissertation, was proposed proprietary metric based on the convolutional neural network, that best detects local areas of reduced quality in images from computer games. The effectiveness of the metric was confirmed in an experiment examining the player's responses, that allow to determine whether the differences between the given values of individual graphic settings are noticeable (with statistical significance) to the average observer and whether these responses coincide with the indications of the metric.

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