Measuring image quality made easier with new computational methods

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Researcher Mikko Nuutinen has developed methods for measuring the quality of digital and printed images computationally with algorithms directly from natural images. These unprecedented methods are presented in his doctoral dissertation for the Department of Media Technology.

The research and development of imaging systems – cameras and printers – require objective measures of image quality, in addition to subjective measures sourced from evaluations of test subjects. Objective computational methods aim to predict the subjective criteria for quality as accurately as possible.

"The research of image quality must keep up with the constantly improving applications in imaging and camera technology. The best possible quality is sought for by comparing objective computational values to how the final and actual image is perceived," explains Nuutinen the basics of image quality research.

Algorithms and reference cameras to replace expensive test target metrics

Measuring image quality is currently based on the use of so-called test target images and extracting quality criteria from them. A test target image is of a field, which contains known information for example of colour modulation or sharpness.

"They are used to estimate, how a camera has distorted certain parameters, such as colour differences, unevenness or noise."

Test target metrics require a laboratory, and their results do not match actual, real-life situations. They tell more about how cameras function than of the perceived quality of images.

"When comparing the quality of images produced by different cameras, both subjective and objective measures are needed. Nowadays the latter require test target images. In my dissertation I show how the same objective measurements can be produced more accurately and altogether without test target images and the expensive and time-consuming laboratory conditions they demand," explains Nuutinen.

Nuutinen has developed algorithms to assess so-called low-level quality attributes: sharpness, graininess and colour contrast in printed images, and sharpness, colour noise and colour difference in images in digital camera systems.

"Instead of scanning prints, we digitise the images by taking several pictures of them in different exposures with high-quality reference cameras. The computational methods utilise these to calculate objective quality measurements."

"In camera applications, the methods search for specific details in the reference camera images and their counterparts in the natural images to be measured. Desired quality values are then calculated from them."

Direct computation of natural images?

Computational quality analysis has with Nuutinen's research taken a step forward towards subjective assessments made by people about, for instance, the naturalness of images.

"Computationally measuring high-level attributes such as naturalness or clarity would require even better algorithms."

Next, Nuutinen will pursue to develop no-reference methods, that is, robust algorithms, which would be able to assess the quality of natural images completely without reference images.

"With the help of image databases currently under construction, no-reference algorithms should be taught to recognise all kinds of distortion types in images. The types of algorithms we have now are unable to analyse natural images taken with any given camera."

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