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Linz, 9. Dezember 2014

Teaching Plastic Film How to See

In 2013, the Institute of Computer Graphics of the Johannes Kepler University (JKU) Linz presented the world's first flexible and transparent image sensor to the public. The head of institute, Prof. Oliver Bimber, and his team have now developed an innovative machine-learning technique that enables the reconstruction of almost needle-sharp images.

The sensor consists of thin, transparent polycarbonate film dotted with fluorescent particles. Light transmitted to the film is partially absorbed, emitted in another wavelength inside of the film, and then transported towards the edge of the film. At this point, sophisticated techniques are used to measure a two-dimensional light field (meaning the amount of light that escapes from the edge of the film in every position and every direction). This light field can be used to compute the image which is optically focused on the film's surface.

New method

Previously applied imaging reconstruction techniques are similar to the techniques applied in computer tomography. In this case however, the image quality suffers under a pure computational approach. The new method no longer computes images stemming from light measurements but instead, the sensor is taught one time how to incorporate thousands of random images and thereby learns how to reconstruct high quality images. Images are taken from public online photo databases such as Flickr and Picasa. After sufficient training and applying acquired knowledge in regards to the relationship between image and light signals, the sensor is then able to reconstruct new, arbitrary untrained images. The training session extracts information that is too complex to be mathematically formulated and applying this learning approach significantly improves image quality.

The new results within the scope of the project will be published in a third article in the renowned journal of the Optical Society of America (OSA), Optics Express. In addition to the initial sensor presentation in 2013, earlier this year the possibilities of depth reconstruction using the sensor were also published in the journal.

Cooperation with Microsoft

Funded by Microsoft, the interdisciplinary base-knowledge research project aims to develop new technology that could extend the abilities of conventional touch sensors we find in many devices today.

Prof. Bimber remarked: *“Although we are primarily conducting base-knowledge research, we are on the threshold of far-reaching applications.”* In the future, the new technology could, for example, be integrated into car windshields which could then monitor the state of the driver and passengers, or be used to evaluate how long a customer views a store window display.

Prof. Bimber’s project team is already working on advanced methods that will not only teach the sensor how to see images, but also understand them.

Video: <http://youtu.be/oVIPSjiEMww>

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