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Inspiration from the Animal Kingdom: The World's First Flexible, Transparent Image Sensor Now Calculates an Object's Depth

In 2013, Prof. Oliver Bimber and Alexander Koppelhuber M.Sc. (Institute of Computer Graphics, JKU) presented innovative new technology to the world: the first bendable and completely transparent image sensor. In cooperation with Microsoft Research, both researchers from Linz are now working on another breakthrough: an image sensor capable of calculating an object's depth. Inspired by nature and the jumping spider, JKU researchers will have the results of their new technology published in the renowned scientific journal "Optics Express".

Jumping spiders have an interesting, distinguishing characteristic: they possess static vision. Whereas the human eye will focus on a distant object, jumping spiders use image defocus to estimate depth and precisely capture their prey.
Prof. Bimber explained: "We have adopted these principles of depth perception." Similar to that of the jumping spider, the researchers reconstructed the objects depth based on defocus.

Multifunctional Thin-Film

The multifunctional thin film sheets will now have even more features. In principle, the transparent film contains luminescent concentrators that absorb the light from specific wavelengths. These wavelengths discharge lower frequency and the emitted light is forwarded towards the film's edges. Photo sensors and a special optical trick can measure the light components being transported to the film's edges. The two-dimensional light field measured at the edges can then be used to reconstruct the image and now also the depth – of objects in front of the foil. This is possible because the new film can shift its focus perpendicular to the film surface without any lenses. Using this information on defocus, the depth is then calculated. "*In addition to depth reconstruction, our technology revealed*

another novelty: multifocal imaging." This means that multiple images can be generated at a different level of focus without using lenses. This is not just theoretical research but allows – among other things – the development of a new generation of non-contact touch screens.

Even More Flexibility

The development of revolutionary innovations such as this requires expertise from many different scientific fields. Prof. Bimber emphasized the interdisciplinary approach: "There are many disciplines in play, ranging from mathematics and material sciences to computer science and natural sciences." In the global research race for new optical sensors, the JKU has a leading edge. The new sensors can be created in any size, can vary in flexibility, and can even be placed in layers over one another. Prof. Bimber added: "*This means being able to record light and dark areas simultaneously and things like overexposure and underexposure in high contrast photos made by today's cameras will be a thing of the past.*"

Wide Range of Applications

The sensor is particularly interesting in regards to new human-computer interfaces. "*The main application would be non-contact touch sensors*." In addition to lensless cameras, the film could also be used as "smart skin" to improve independent interaction between robots and people. Prof. Bimber added: "*We could also to turn any object – such as a car windshield for example - into an image sensor*." Gamers could also benefit in the future: 3D sensors for game consoles, such as the Kinect system for the X-Box, could be a potential target application for the new techology.

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