Technological offer

New method makes corneal topographic maps in less than a second

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Scientists at CSIC have developed a method that enables obtaining a corneal topographic map in less than a second. Compared to current technologies, the new technology is faster and has higher resolution and exactitude. Besides ophthalmology, it can be used in other sectors, like microelectronics or biomedicine. The method can measure surface's profiles at shorter distances than current technologies, without touching the object, which prevents any possible harm. It can get the measures even if the object is within a liquid.

Three-dimensional corneal image.

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Seeing the inside of the eye with high resolution is possible through the optical coherence tomography (OCT) technology which obtains three-dimensional corneal images. As a matter of fact, the use of OCT is widely used by specialists because it allows us to quickly see the whole cornea.

Nevertheless, what this technology can't do is to obtain an elevation quantitative map or a topographic map with the corneal thickness and irregularities. This is because, though it has high resolution, OCT has a small distortion which is called fan (or field) distortion and that can derivate in erroneous measures.

To obtain these correct measurements it is essential for planning treatments such as refractive surgery, implants or to adjust contact lenses. That's why specialists have to use other techniques that are slower and have less resolution but can make corneal measurements. Examples of these techniques are the Scheimpflug imaging and Placido-based videokeratography.

Now, a scientific team at the CSIC's Instituto de Optica "Daza de Valdes" has patented a new method that overcomes the fan distortion. Scientists are looking for companies interested in the technology.

Lead by Susana Marcos, scientist at the Visual Optics and Biophotonics Lab , the team has developed a series of algorithms to calibrate the OCT tool, to correct fan distortion and obtain a corneal topographic map. A striking benefit of the method is that it can be applied to any conventional OCT system, so it's not necessary to change the equipment.

As Susana Marcos explains, "it allows one to obtain a complete map of corneal irregularities in less than a second". In a single shot it captures the elevation map of the front and the back cornea, and a thickness map that has a high exactitude and maintains the OCT system precision in micrometers scale. Also, the acquisition speed prevents mistakes derived from patient movements.

Scientists have successfully applied the system to patients with no special disease in the

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eyes and patients affected by keratocon (a progressive disease which occurs when the cornea thins and weakens in different points) with intrastomal corneal implants.

The results have been published in the Biomedical Optics Express magazine. The article has been in the last months one of the most read, and highly surpasses the average of downloads.

Applications are not limited to the eye exploration. As Susana Marcos adds, it can be applied to obtaining surface profiles of any structure that allows light to pass through. Marcos adds that "by its nature, the eye is perfect for this technology, but it could be used also for supervising lenses or for cardiological, oncological or dermatological explorations, used in combination with an endoscope.

"This is a non-contact technique", remarks Susana Marcos, "it doesn't touch the surface that measures, is light which does. So this is a great advantage when the materials or tissues are delicate". That means, also, that it is possible to work at larger distances than other techniques. Or that it is possible even to measure surfaces that are inside a liquid, with a high speed of acquisition (to 100.000 pixels per second). Comparatively, one of the most used techniques for supervising lenses, the microscopy, makes it necessary to place the lens very near the microscope and constantly and progressively change the focus and scan through the whole lens.

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