Centre for Nanoscale BioPhotonics
ARC CENTRE OF EXCELLENCE

MEDIA RELEASE

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In-body fibre optic imaging to go 3D

An advanced new method has been developed by researchers that may open the door to 3D microscopy in hard-to-reach areas of the human body.

It sees the successful miniaturization of a 3D imaging technique called 'light field imaging', taken to extreme new levels, making in-body application possible. It could find significant application in diagnostic procedures called optical biopsies, where suspicious tissue is investigated during medical endoscopic procedures.

Reported in the journal 'Science Advances', the innovative imaging approach was reported by researchers at the ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP).

"Until now, light field imaging has only been possible with relatively bulky hardware, such as camera arrays or modified consumer cameras," says Dr Antony Orth, project lead and Research Fellow at the RMIT University node of the CNBP.

"Rather than attempt to shrink existing systems, we realized that the optical fibre bundles routinely used for microendoscopy were already suitable light field imaging devices themselves."

Optical fibre bundles are collections of tens of thousands of microscopic optical fibres. Each fibre in the bundle acts like a pixel in a camera, resulting in a 2D image being transmitted through the fibre bundle.

In addition to recording a 2D picture, light field imaging systems also measure the incoming angles of all the light rays in the picture. With this information, the picture can be mapped in stereo 3D, in the same way that humans perceive depth.

"The main challenge is how to record this often-elusive angular light ray dimension," says Dr Orth.

“The key observation we made is that light ray orientation information is actually transmitted by the optical fibre bundle microendoscope – you just need to know what to look for and how to decode it."

“When you look closely at light emerging from each microscopic optic fibre, you find that it does so in a pattern that depends on its input angle.”

“With the right mathematical framework, we can decode these patterns, turn them into a light field, and do all the amazing things you can do with light fields such as refocusing, depth mapping and stereo 3D visualization.”

Dr Orth believes that the light field technology has the potential to bring a whole new depth dimension to optical biopsies. This is where suspect tissue is examined without a sample having to be taken from the patient.

“This will make optical biopsies more informative while simultaneously improving microendoscope ease of use since we can retroactively refocus out-of-focus images,” he says.

“We’re currently talking with physicians about how best to test our technique in the clinic, and identifying the medical procedures most likely to benefit from 3D visualization at the microscale.”

CNBP scientists affiliated with RMIT University, Macquarie University and Swinburne University of Technology worked on this break-through imaging development.

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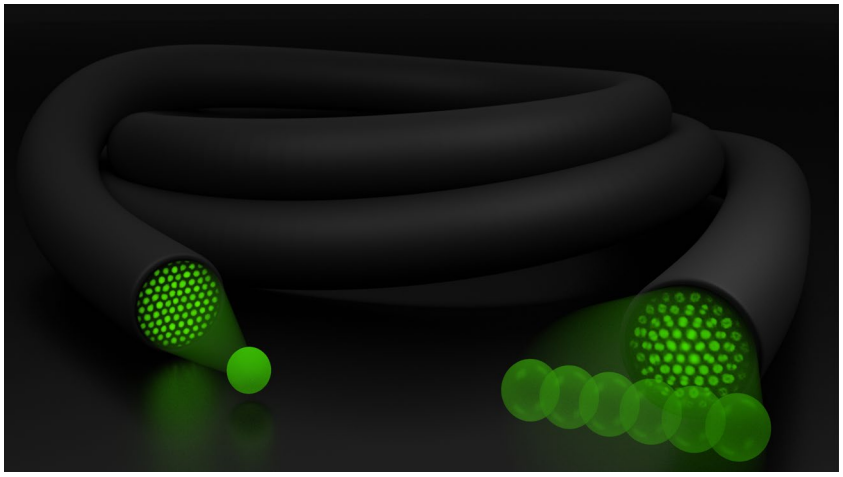
RESEARCH PAPER:
Optical fiber bundles: ultra-slim light field imaging probes.
http://doi.org/10.1126/sciadv.aav1555

IMAGES AVAILABLE:
Dr Antony Orth (landscape) - https://flic.kr/p/23by9fh
Dr Antony Orth (portrait) - https://flic.kr/p/24dxwR9
Modal structure in optical fiber bundles captures light field information (1).
https://flic.kr/p/24StBHV
Modal structure in optical fiber bundles captures light field information (2).
https://flic.kr/p/2e69s3c



Modal structure in optical fiber bundles captures light field information.

VIDEO AVAILABLE:
In-body fibre optic imaging to go 3D -
https://www.dropbox.com/sh/9bvnid7thzcnna9/AADYZtKf8yUn8d69nrW-F8F7a?dl=0

ABOUT:
The Centre for Nanoscale BioPhotonics (CNBP) is an Australian Research Council Centre of Excellence led by the University of Adelaide, with research focussed nodes also at Macquarie University, RMIT University, Griffith University and UNSW Sydney. A $40m initiative, the CNBP is focused on developing new light-based imaging and sensing tools, that can measure the inner workings of cells, inside the living body. http://cnbp.org.au/

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