# Optical coherence tomography

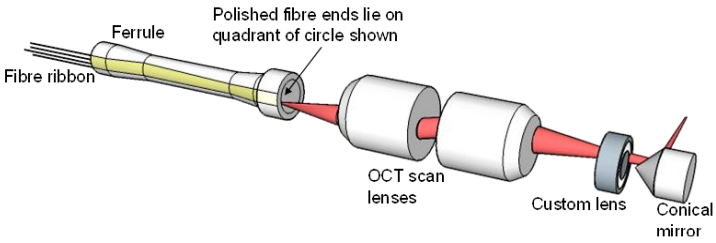
## Optical coherence tomography (OCT)

- Non-invasive optical depth-sectioning with micrometre-scale axial and lateral resolution, using infra-red illumination
- Interferometric extraction of information at very high signal-to-noise ratio
- Fast, high-res imaging for inorganic and biological samples, including agrifood and medical diagnostic applications
- OCT application examples at Cranfield
  - Crop disease studies in onions and mandarin oranges
  - Adhesive cure monitoring via relative viscosity measurement
  - Thickness monitoring of biofilm growth in water treatment plant

## Our approach: OCT instrument development

Application-led OCT instrumentation development at Cranfield includes

- *Passive OCT profiler for duct inspection:* Spatially-multiplexed OCT systems using optical fibre bundles and custom arrays

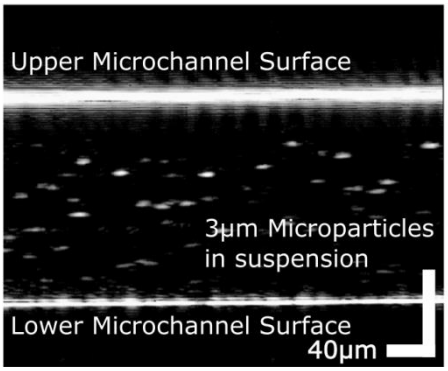



- *Remote refractive index determination:* Integration of OCT with confocal microscopy for high-precision, non-contact thickness and refractive-index measurement

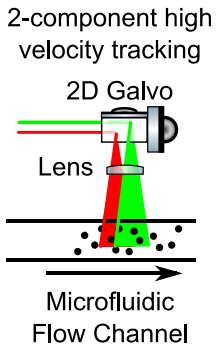
## Example application: dual-fibre scanning for microfluidic flow velocimetry

Dual-beam OCT for particle tracking in microfluidic flows. A fibre pair, appropriately orientated in an OCT sample arm, allows two time-shifted images to be obtained from a single mirror scan, with a time interval dependent on fibre separation. Hence imaging interval is decoupled from galvanometer scan rate.

Measurable velocity range is extended by up to about one order of magnitude without the need to upgrade speeds of scanning and acquisition components.




**(a)**




**(b)**

(a) Particle flow in 100 μm deep microchannel.
(b) Acquisition of image pair from a dual-fibre OCT sample arm.

### Further information:


[1] H D Ford and R P Tatam, "Passively-coupled, low-coherence interferometric duct profiling with an astigmatism-corrected conical mirror", *Opt. Express*, **25**, pp. 8896-8915, 2017.

[2] H D Ford and R P Tatam, "Spatially-resolved volume monitoring of adhesive cure using correlated-image optical coherence tomography", *Int. J. Adhes. Adhes.*, **42**, pp. 21-29, 2013.


Centre for Engineering Photonics

# Centre for Engineering Photonics

## About Cranfield University

Cranfield is an exclusively postgraduate university that is a global leader for transformational research in technology. Cranfield is focussed on the specialist themes of aerospace, defence and security, energy and power, environment and agrifood, manufacturing, transport systems, and water.

Cranfield has the largest number of engineering and technology postgraduates in the UK, awards over five percent of the UK's engineering and technology PhDs each year and currently works with over 1,500 companies and organisations worldwide.

Cranfield is ranked in the top five of UK universities for commercial research income, with 81% of Cranfield's research classed as world-leading or internationally excellent by REF (Research Excellence Framework, 2014). Cranfield University was formed in 1946 as the College of Aeronautics, the first postgraduate college of its kind.

## The Centre for Engineering Photonics

Engineering Photonics at Cranfield is recognised internationally as a leading centre for optical sensing and instrumentation, which, since its inception in 1989, has been led by Professor Ralph Tatam. Engineering Photonics undertakes research ranging from blue skies concepts to the development of prototype instrumentation that is used by us and our academic and industrial collaborators in real environments. Further information about the Centre and a full list of publications and links can be found at openoptics.info.

## Research areas

Engineering Photonics applies advanced photonic technologies to solve challenging measurement problems. Our research underpins measurements across a wide range of industrially important areas such as: aerospace, healthcare, manufacturing, transport, automotive, environment and agrifoods. We work in collaboration with academia, SMEs and major international companies both nationally and internationally.

## Technologies

Optical interferometry; optical fibre sensor technology including interferometry, FBGs and LPGs; optical imaging and image processing; optical gas sensing; speckle interferometry and metrology.

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