Crossroads

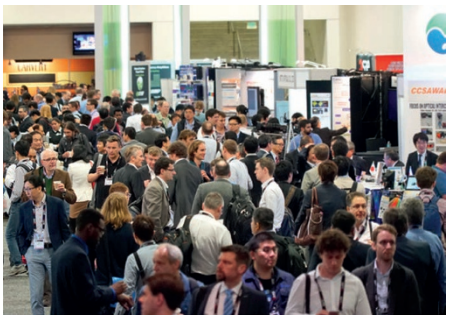
The merger of biology and optics was the focus of new sessions at SPIE Photonics West 2016. The conference attracted over 20,000 attendees.

It's no secret that Photonics West is one of the biggest meetings in the optics calendar. From 13–18 February, the Moscone Centre in San Francisco hosted 22,400 registered attendees and had 4,800 presentations on offer. In addition, 1,342 companies were at the Photonics West exhibition and 211 at the BiOS Expo (although there is some overlap between the two events).

With so much content at the meeting, we focused on sub-conferences that were new to Photonics West this year. For nonlinear optics, in the LASE section, there was the new theme on 'Real-time measurements, rogue events, and emerging applications'. In the BiOS meeting, which is concerned with biophotonics, there were also multiple new sub-conferences. Of particular interest was the conference titled 'Biophysics, biology and biophotonics: the crossroads', which embraced a range of topics where the biological and optical sciences meet. Some research focused on the use of optical techniques as tools in biological or medical research, whereas others focused on the reverse — taking a biological system as the inspiration for new photonics.

An example of bioinspired photonics was given by Mathias Kolle, from the Massachusetts Institute of Technology, who gave a talk on cephalopod (a mollusc class including octopuses, squid and cuttlefish)-inspired photonics. He discussed mechanoresponsive, colour-tunable, photonic fibres and reconfigurable fluidic compound microlenses. Kolle told *Nature Photonics* that the "work is focused on broadening the scope of materials used in optical engineering to include soft and fluid materials that can impart multiple functionalities and dynamic, stimuli-responsive behaviour to an optical material/device, similar to the colour- and shape-variation capabilities in cephalopods."

In addition to bioinspired photonics, another major theme was using light to garner critical information about biological material such as proteins. For example, due to their importance in biological processes it is useful to optically detect when proteins bind or interact, but it is not easy to do in liquid solution because the refractive-index variations are small. One presentation pointed out that it is possible when one of



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the interacting protein partners is tethered onto a solid surface, leading to a high local density of bound partners. This work, by Manoj Varma and colleagues from the Indian Institute of Science, Bangalore, also aimed to clarify some inconsistency between existing experiments and theory.

Also working with the refractive index of biological samples, Jeremy Rogers from the University of Wisconsin-Madison gave a talk on optical scattering by tissue. This area has been of interest for some time because the scattering properties of tissue can reveal risk of cancer. While in the previously mentioned work Varma hits on the issue of small refractive-index contrast, here Rogers deals with the small spatial scale (tens of nanometres) of refractive-index variation in tissue, which is problematic from the point of view of optical imaging.

"Statistical models of the refractive-index-correlation function provide a link between the length scales at which alterations occur in tissue and the scattering properties that can be measured clinically," Rogers told *Nature Photonics*. He explained that the work demonstrates the ability to measure angular scattering from tissue and convert this to a refractive-index-correlation function without assuming a specific functional form or prior knowledge, which is often required with other approaches.

Light is also being used to detect ratios of living cells to dead cells. Fang Ou, Rachel Guo, Cushla McGoverin and colleagues from Auckland, New Zealand, explained that the proportion of live to dead bacteria is important for testing antibiotics and other treatments such as ultraviolet irradiation. Whereas existing approaches use bulky flow cytometry and fluorescence microscopy, here the team discussed a compact and portable scheme.

They developed a new method for identifying live versus dead bacteria using an inexpensive and portable fibre-based fluorometer optrode — an optical sensor for detecting substances that typically uses a chemical transducer. Their optrode uses SYTO 9 (a dye that shows living cells) and propidium iodide (which reveals dead cells) fluorescence intensity in bacterial solutions. McGoverin told *Nature Photonics* that "the optrode greatly reduces the processing time of any fluid, such as swabs from surfaces in industrial settings, and is ideal for gaining insight into the way a biocide operates."

Fluorescence is also being used to study cancer. Fluorescence-lifetime imaging based on time-correlated single-photon counting was used as a label-free approach to quantify tumour heterogeneity by Tiffany Heaster and a team from Vanderbilt University and the Air force Research Lab. "Autofluorescence lifetimes of intracellular metabolic coenzymes distinguished proliferative, apoptotic, and quiescent cell populations," Heaster explained. "The identification of quiescent cell populations is particularly significant due to the role of quiescent cells in driving treatment resistance and tumour recurrence."

Imaging is also being used to assess other biological cell properties. Adam Wax from Duke University presented work that showed that the nanoscale sensitivity of quantitative phase imaging can be used to assess cell stiffness, disorder strength, and subtle changes in the mass distribution. Wax reported that the disorder strength correlates with the mechanical stiffness, suggesting that detection of disorder could provide a way to assess cell mechanical properties without applying a stimulus.

SPIE Photonics West 2017 is scheduled to take place from 28 January to 2 February 2017 at the Moscone Centre in San Francisco — see you there next year. ❐