Breaking down barriers

Closer collaboration between physicists, engineers and biologists is vital for the future success of biophotonics.

Barriers between the communities of photonics and biology must be bridged more effectively if the discipline of biophotonics is to fulfil its true potential.

Historically, the two communities have tended to work in isolation, speaking different scientific languages, publishing in different journals, attending different conferences and working in different departments.

The good news is that this behaviour seems to be changing, and that increased collaboration and mixing between those working in the life sciences and the physical sciences is likely if sufficient efforts are made. Indeed, the dramatic growth in the attendance and submissions to SPIE's BiOS biophotonics conference (www.spie.org/x13196.xml), which takes place at the beginning of each year in California as part of the giant Photonics West event, gives cause for optimism. Another cause for optimism is the launch of new journals in the field of biophotonics, such as SPIE's Journal of Biomedical Optics or the Optical Society of America's Virtual Journal for Biomedical Optics.

As an enabling technology, photonics has already proven itself to be capable of providing innovative solutions to a wide range of applications across a diverse set of sectors. Just look at the impact that photonics has already had in information technology, where the adoption of optical fibres and semiconductor lasers has transformed the speed and efficiency of data communications, and supported the proliferation of the internet around the globe. In the material processing sector, efficient and powerful solid-state lasers such as diode-pumped Nd:YAG, fibre lasers and thin-disk lasers are now the tools of choice for many manufacturing tasks such as drilling, cutting and joining parts of cars, and fabricating solar cells.

There are already indications that photonics could have a similar level of impact in the world of biomedicine. Photonics is already aiding biomedicine through the development of laser eye surgery, photodynamic therapy, neurophotonics and many forms of sensing and imaging such as confocal, photoacoustic, fluorescence, optical coherence tomography and multiphoton microscopy.


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However, owing to the complexity of the human body, the need for clinical trials and regulatory approval, and the difficulty in securing venture capital given the risks involved, the development and commercialization of photonics-based solutions in the life sciences is arguably harder to achieve than in other fields. Success relies crucially on bringing together biologists, physicists and engineers.

"The gap between these communities exists mainly because of tradition, and because it is difficult to cross the border into another scientific field. Put simply: it is difficult to follow discussions in another area. I might attend a conference in medicine or biology, but it would be difficult to understand the key challenges. It is the exact same situation for a clinician attending a photonics conference," explained Peter Andersen, a biophotonics researcher at the Technical University of Denmark in Roskilde.

However, Andersen points out that the benefits of improved collaboration are well worth pursuing. He explains that better cross-disciplinary interaction between researchers in biology and photonics would not only aid the development of new and enhanced diagnostic tools, but also provide a better understanding of cellular functions. In particular, he emphasizes the benefits that photonics could provide for imaging at resolutions beyond the diffraction limit and for sensing at extremely low concentrations. "In biology, they have challenges to which the photonics community might have ideal solutions," he explains.

As for how this gap could be better bridged, Andersen says that there are several ideas that could be implemented to enhance cross-fertilization between the communities. "In the near-term, focused events where biologists, biochemists and clinicians explain their immediate and long-term challenges to an audience of physicists and engineers would put the relevant challenges on the map," he told *Nature Photonics*. "Joint statements from such events can be addressed not only to national and European funding agencies, but also to private companies and venture capitalists, because there are sufficient scientific and economic drivers."

"In the long-term, we must address the way we teach topics such as biology, medicine and technical sciences in high schools and universities," explained Andersen. One opportunity is to create new interdisciplinary degree courses in biophotonics that are organized and run jointly by physics and biology departments.

Andersen says that some successful bridging activities have already taken place. For example, in 2010, a workshop at Photonics Europe in Brussels allowed clinicians, pathologists and biologists to give their opinions on how the field could benefit from new technology. A similar situation was found at the Work Group 3 meetings of Photonics 21.

Next year, Andersen is co-organizing Biophotonics '13, an international graduate summer school on biophotonics that aims to inspire and educate the next generation of biophysicists (www.biop.dk/biophotonics13). Talks will be given by leading scientists in the field, including Stefan Hell (super-resolution fluorescent imaging), Kishan Dholakia (optical trapping and manipulation), Lihong Wang (photoacoustic imaging), Wolfgang Drexler (optical coherence tomography) and Katarina Svanberg (photodynamic therapy). "Although the main scope of the conference is teaching, we hope that by mixing topics and students we can fertilize cross-disciplinary interactions, and that these relations might also be sustainable in the long-term." ❐