David C. C. Lam: better tools to catch the vision thief

Received: 10 June 2018; Accepted: 25 June 2018; Published: 30 June 2018.
doi: 10.21037/aes.2018.06.04
View this article at: http://dx.doi.org/10.21037/aes.2018.06.04

Expert introduction

David C. C. Lam (*Figure 1*) is Professor of Mechanical and Aerospace Engineering and Associate Director of Center for Advanced Microsystems Packaging at the Hong Kong University of Science and Technology. He conducts basic research in nanocomposite and nanoporous material processing and development with applications in electronics packaging. He applies the basic research results in the development of contact lens sensor for glaucoma and diabetes and develops thrombectomy and advanced coiling devices for strokes.

Figure 1 Prof. David C. C. Lam.

Editor's note

On April 21 and 22, 2018, the 2nd Guangzhou Glaucoma Forum was successfully held at Zhongshan Ophthalmic Center, Sun Yat-sen University.

With numerous of outstanding experts worldwide gathering together, this meeting was no doubt a grand feast which covered all the significant topics and latest developments across the field of ophthalmology. Topics include new treatment in retinal and vitreous disease and glaucoma, integrated images analysis and early diagnosis of glaucoma, minimally invasive surgical procedures, pediatric glaucoma, neuroprotection and translational medicine.

Prof. David C. C. Lam was one of the speakers and the special topic he gave was "Better tools to catch the vision thief: new ocular probe, monitor and indicators". On behalf of the Editorial Team of *Annals of Eye Science* (*AES*), I had the honor to interview Prof. Lam and Prof. Lam spoke about the multidisciplinary engineering-medicine-computational approach to develop new methods for detecting and treating ophthalmological diseases including glaucoma (*Figure 2*).

Figure 2 Photo with Prof. David C. C. Lam after the interview.

Interview questions

AES: Could you briefly introduce yourself to our readers?

Prof. Lam: I'm David, a professor in the Department of Mechanical and Aerospace Engineering. My researches have focused on the intersection of mechanics, materials and electronics. More recently, my research group has focused on developing medical devices for ischemic stroke and for ocular diseases. Our target is to develop devices, methods and treatments for early detection of diseases to help the ophthalmologist and optometrist to identify and halt blindness progression in diseases such as glaucoma which causes irreversible blindness. Amongst the devices in our investigation, we are developing non-invasive contact lens sensor and monitors to enable early detection of glaucoma

and early treatment without surgery.

AES: How do you integrate material science with eye science?

Prof. Lam: We are working in the intersection of multiple fields. If one can envision one field as one axis in a solution landscape, medicine by itself would be a single axis. The combination of medicine and material science would open up the originally one-dimensional world. The intersection of the material science axis and the medicine axis creates a world that is more graphical than a world with only one dimension. A graphical 2D world can feature and host many useful solutions that can be readily understood from a materials-medicine perspective, but were unavailable from a medical or a materials perspective alone. We integrated materials science into medicine by building devices and solutions for the doctors to test and try. We have had successes in this 2D world, but we can do better. We found that transformative solutions that are not available in the 2D world maybe found by applying machine learning. We started integrating machine learning into our materials-medicine world, and found transformative solutions in the intersection of these three fields/axes, i.e., in the 3D world of machine learning-materials science-medicine. We are still learning about the discovery power in this 3D intersection, and are trying to integrate them together. Thus far, the addition of machine learning enabled us to make vital progress in key diagnostic areas in glaucoma, and we are hopeful that we can do the same in the treatment arena and in diseases beyond glaucoma.

AES: Could you share with us the latest tools for ocular probe and monitor in clinical practice?

Prof. Lam: I can perhaps give an example on developing a new medical device in the interaction of medicine-materials-machine learning. The medical doctors had been using intraocular pressure as a primary indicator for glaucoma for a few decades. Attempts had been made to improve on its accuracy, but few can demonstrate diagnostic success rate that are significantly better than the classical IOP measurement device, i.e., the Goldmann Applanation Tonometer. For simplicity, we can define IOP as the single medical axis. Material science of the eye teaches us that the cornea behaves viscoelastically. We built a device to characterize the viscoelastic response of the cornea to indentation, and use the data to build a second axis. We further added machine learning as a third axis and created the intersection of three axes. At the intersection, we were able to develop diagnostic methodologies that can detect glaucoma with over 95% accuracy without the help of imaging. This enabled us to develop a new diagnostic technique to detect glaucoma before structural damages on the retina can be observed using conventional imaging techniques. The ability to detect early-stage glaucoma needs to be tested, but results show that normal tension glaucoma can now be detected with this technique. I am hopeful that more devices and treatments can be developed at the intersection of the medicine-materials-machine learning.

AES: What are the new research projects in your team?

Prof. Lam: There is a lot of work ahead. Knowing that one has glaucoma is helpful for the clinician, but detail pathology is needed to recommend proper treatments. We are trying to develop disease-specific diagnostic indices to enable differentiation of diseases so that clinician can have higher confidence in recommending proper treatment.
Another project that we had been working on is smart drug delivery in contact lens. The smart contact lenses not only monitor the biophysical condition of the eye, but also deliver drug to the eye, and monitor the changes as a function of drug delivered. There are a number of devices that in testing now, and we hope that we will be able to report exciting results on these new developments the next time we meet.

AES: As we know, ophthalmology requires a high degree of precision. How do you guarantee the precision of ocular devices?

Prof. Lam: The precision in diagnosis is addressed from the root. Instead of working on a single diagnostic dimension and its accuracy, our approach is to first expand the diagnostic space from 1D to 2D and to 3D and so on. This requires us to develop not only the hardware, the software, but also how the new information is used in the new 3D ecosystem. So, instead of trying to increase IOP measurement accuracy, precision in diagnostic accuracy in our system is brought about by expansion and diagnostic mapping of the new 3D diagnostic ecosystem.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Annals of Eye Science* for the series "Meet the Professor". The article did not undergo external peer review.

Conflicts of Interest: The authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/aes.2018.06.04). The series "Meet the Professor" was commissioned by the editorial office without any funding or sponsorship. Cheng-Ying Lin and Tung-Lun Shih report that they are full-time employees of AME publishing company (publisher of the journal). The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

(Science Editors: Cheng-Ying Lin, Tung-Lun Shih, Annals of Eye Science, aes@amegroups.com)

doi: 10.21037/aes.2018.06.04
Cite this article as: Lin CY, Shih TL. David C. C. Lam: better tools to catch the vision thief. Ann Eye Sci 2018;3:36.