Exponent®
Engineering & Scientific Consulting

Wallace Hui, Ph.D.

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Professional Profile

Dr. Hui's expertise spans a wide range of technologies, including consumer electronics, optoelectronic devices, optical imaging instruments, biomedical devices, MEMS and optical sensors, micro/nano-scale device design and prototyping.

At Exponent, Dr. Hui assists clients with resolving complex issues related to PCBA failure analysis from the board level down to the component level, electromagnetic characterization of medical devices, optical metrology, RF and optical electromagnetic safety and risk assessment.

Dr. Hui has over 10 years of experience in the design, characterization, debugging, modeling and simulation of optoelectronic devices, optical and MEMS devices, sensors, and optical imaging systems. He also regularly performs various types of electromagnetic field evaluations for biomedical devices and consumer electronics as well as EMI and EMC assessments.

Dr. Hui has extensive experiences in designing nanophotonic and micromechanical devices with various numerical simulation tools (e.g. rigorous coupled wave analysis, COMSOL) at Harvard University and University of Pennsylvania, fabricating the devices with a suite of micro/nanofabrication techniques in Class 1000 cleanroom facilities, and characterizing their optical, electrical and mechanical properties with various optoelectronic techniques and instrumentations.

Prior to Exponent, Dr. Hui's contributions to the biomedical community includes devising novel optical imaging schemes and constructing implantable photonic devices to fulfill unmet needs especially in ophthalmology. On the optical imaging front, Dr. Hui developed his expertise in optical coherence tomography (OCT) and coherent imaging at the Wellman Center for Photomedicine at Harvard Medical School. There he devised and constructed a highly parallelized axial-ranging technique by virtue of the complex yet tractable mode space of multimode fibers, broadband semiconductor optical amplifiers, and grating-based off-axis holography techniques for spatial demodulation. He is also experienced in a host of imaging and signal processing algorithms, including compressive sensing.

Dr. Hui has substantial experiences in the intersection of ophthalmology and biomedical devices. On the implantable optical device development front, Dr. Hui played a pivotal role in devising an optical approach for facilitating intraocular pressure sensing and glaucoma management in patients with artificial corneas (keratoprothesis) at Harvard Medical School and Schepens Eye Research Institute/ Massachusetts Eye and Ear. There he integrated a fiber-optic Fabry-Perot pressure sensor directly into artificial cornea implants. He also designed and implemented a micromagnet-based fiber-optic self-alignment mechanism for rapid engagement and interrogation through an external fiber-optic probe, which was validated with animal models. Furthermore, Dr. Hui also devised and implemented the benchmarking experiments and the theoretical framework for evaluating the intrinsic optical properties and imaging performance of the Boston keratoprosthesis in accordance with the ISO 11979-2:2014 standards. Finally, Dr. Hui is also

experienced with conducting clinical studies through rigorous modeling and statistical analyses. In particular, he investigated the relationship between OCT-derived optic nerve head structural parameters and the functional visual-field results in healthy and glaucoma subjects, with the goal of providing guidance for disease detection.

In addition, Dr. Hui's contributions to the broader biosensing community consist of developing wearable optical drug-sensing devices enabled by Bloch surface waves structures, and photonic crystal-based colorimetric sensor array for volatile organic compounds in the context of disease detection at University of Pennsylvania.

Academic Credentials & Professional Honors

Ph.D., Engineering Sciences, Harvard University, 2014

S.M., Engineering and Applied Sciences, Harvard University, 2012

B.S., Applied and Engineering Physics, Cornell University, 2008

Croucher Foundation Fellowship, 2014

Tau Beta Pi, Engineering Honor Society, 2007-2008

Prior Experience

Visiting Scientist, University of Pennsylvania, 2020-2021

Postdoctoral Fellow, Harvard Medical School/ Schepens Eye Research Institute/ Massachusetts Eye and Ear, 2017-2021

Postdoctoral Fellow, Harvard Medical School/ Wellman Center for Photomedicine/ Massachusetts General Hospital, 2014-2016

Teaching Fellow, Harvard University, 2010

Summer Intern, Corning Incorporated, 2008

Teaching Assistant, Cornell University, 2008

Student Researcher, Cornell University, 2006-2008

Professional Affiliations

Optica, Member

Institute of Electrical and Electronics Engineers (IEEE), Member

SPIE, Member

Association for Research in Vision and Ophthalmology, Member

Languages

Mandarin Chinese

Cantonese Chinese

Publications

1. Implantable self-alignment fiber-optic optomechanical devices for in vivo intraocular pressure sensingP. C. Hui, K. Shtyrkova, C. Zhou, X. Chen, J. Chodosh, C. H. Dohlman, E. I. Paschalis, Journal of Biophotonics (2020): e202000031 (selected for cover image)

2. Three-dimensional neuroretinal rim thickness and visual fields in glaucoma: A broken-stick modelW. W. Liu, M. McClurkin, E. Tsikata, P. C. Hui, …, T. C. Chen, Journal of Glaucoma, 29(10), 952-963 (2020)

3. Intrinsic optical properties of Boston KeratoprosthesisP. C. Hui, L. A. Pereira, E. Pei, E. Taniguchi, S. Chen, R. Sayegh, J. Chodosh, C. H. Dohlman, R. Dore, E. I. Paschalis, Translational Vision Science & Technology, 9(12), 10-10 (2020)

4. Single-shot depth profiling by spatio-temporal encoding with a multimode fiberS. Y. Lee*, P. C. Hui*, B. E. Bouma, M. Villiger, Opt. Express 28(2), 1124-1138 (2020) (*co-first author)

5. Nonlinear mechanics of optomechanically actuated photonic crystal membraneP. C. Hui, A. W. Rodriguez, D. N. Woolf, E. Iwase, F. Capasso, M. Lončar. (In preparation - 2016)

6. Classical and fluctuation-induced electromagnetic interactions in micron-scale systems: designer bonding, antibonding, and Casimir forcesA. W. Rodriguez, P. C. Hui, D. P. Woolf, S. G. Johnson, M. Lončar, F. Capasso, Annalen der Physik 527 (1-2), 45-80 (2015)

7. Optical bistability with a repulsive optical force in coupled silicon photonic crystal membranesP. C. Hui, D. Woolf, E. Iwase, Y. Sohn, D. Ramos, M. Khan, A. W. Rodriguez, S. G. Johnson, F. Capasso, M. Lončar, Applied Physics Letters, 103 021102 (2013)

8. Optomechanical and Photothermal Interactions in Suspended Photonic Crystal MembranesD. N. Woolf, P. C. Hui, E. Iwase, M. Khan, A. W. Rodriguez, P. B. Deotare, I. Bulu, S. G. Johnson, F. Capasso, and M. Lončar, Optics Express, Vol. 21, 7258 (2013)

9. Control of buckling in large micromembranes using engineered support structuresE. Iwase, P. C. Hui, D. Woolf, A.W. Rodriguez, S.G. Johnson, F. Capasso, and M. Lončar, J. Michromech. Mircoeng., Vol. 22 065028 (2012).

10. Designing evanescent optical interactions to control the expression of Casimir forces in optomechanical structuresA.W. Rodriguez, D. Woolf, P. C. Hui, E. Iwase, A.P. McCauley, F. Capasso, M. Lončar, S.G. Johnson, Applied Physics Letters, 98, 194105 (2011)

11. Bonding, antibonding and tunable optical forces in asymmetric membranesA.W. Rodriguez, A.P. McCauley, P. C. Hui, D. Woolf, E. Iwase, F. Capasso, M Lončar, and S.G. Johnson, Optics Express, Vol. 19, 2225-2241 (2011)

12. Controlled Interactions of Femtosecond Light Filaments in AirB. Shim, S. E. Schrauth, C. J. Hensley, L. T. Vuong, P. C. Hui, A. A. Ishaaya, and A. L. Gaeta, Phys. Rev. A 81, 061803(R) (2010)

13. Integrated microfluidic devices for terahertz spectroscopy of biomolecules Paul A. George, Wallace Hui, Farhan Rana, Benjamin G. Hawkins, A. Ezekiel Smith, Brian J. Kirby, Optics Express, Vol 16, 1577-1582 (2008)

Presentations:

1. Seeing through the Boston Keratoprosthesis: A detailed optical assessment with natural scene imaging and characterization of the resolving powerP.C. Hui, L. A. Pereira, E. Taniguchi, S. Chen, R. Dore, J. Chodosh, C. H. Dohlman, E. I. Paschalis, Association for Research in Vision and Ophthalmology Annual Meeting, Vancouver, Canada, April 28 – May 2, 2019

2. In Vivo optical monitoring of intraocular pressure in Boston KeratoprosthesisP. C. Hui, J. Chodosh, C. H. Dohlman, E. I. Paschalis, Association for Research in Vision and Ophthalmology Annual Meeting, Vancouver, Canada, April 28 – May 2, 2019

3. Integration of fiber-optic pressure sensors in Boston keratoprosthesis for glaucoma monitoringP. C. Hui, J. Chodosh, C. H. Dohlman, E. I. Paschalis, SPIE Photonics West, San Francisco, CA, USA, February 2-7, 2019

4. Path length-multiplexed optical coherence tomography (Poster presentation)P. C. Hui, M. Villiger, N. Uribe-Patarroyo, B. E. Bouma, Gordon Research Conference – Lasers in Medicine and Biology, West Dover, VT, USA, July 10-15, 2016

5. Spectral reconstruction strategies toward generalized-domain optical coherence tomography with a broadband source and a bucket detectorP. C. Hui, N. Uribe-Patarroyo, M. Villiger, B. E. Bouma, SPIE Photonics West, San Francisco, CA, USA, February 13-18, 2016

6. Strong mechanical nonlinearity of optomechanically driven suspended photonic crystal membraneP. C. Hui, A. Rodriguez, D. Woolf, E. Iwase, M. Khan, F. Capasso, M. Loncar, CLEO/QELS: 2015, San Jose, CA, May 10-15, 2015

7. Cavity optomechanics and the Casimir force: dynamics and applicationsD. Woolf, P. C. Hui, A. W. Rodriguez, E. Iwase, M. Khan, R. Ng, S. G. Johnson, F. Capasso, and M. Loncar, SPIE Photonics West, San Francisco, CA, USA, February 2-7, 2013

8. Dynamics of a tethered silicon photonic crystal membrane due to optical gradient, photothermal and Casimir forcesP. C. Hui, D. Woolf, E. Iwase, I. Bulu, A. Rodriguez, M. Khan, P. Deotare, S. G. Johnson, F. Capasso, Marko Loncar, CLEO/QELS: 2012, San Jose, CA, May 6-11,2012

9. Towards optical manipulation of Casimir force using free-standing membranes with engineered optical and mechanical properties (Invited talk)E. Iwase, P. C. Hui, D. Woolf, A. W. Rodriguez, M. Khan, S. G. Johnson, F. Capasso, M. Loncar, CLEO/QELS: 2012, San Jose, CA, May 6-11,2012

10. Optical bonding and antibonding forces in asymmetric geometries for Casimir force detection (Invited talk)D. Woolf; P. C. Hui; E. Iwase; A. Rodriguez; A. McCauley; I. Lovchinsky; M. Khan; S. Johnson; M. Loncar; F. Capasso, CLEO/QELS: 2011, Baltimore, MD, May 4, 2011

Project Experience

Conducted printed circuit board assembly (PCBA) and electronic component failure analysis.

Conducted failure analyses on power adapters, microelectronic components, and high-power RF coax cables.

Evaluated the safety requirements for static magnetic field exposure in the presence of medical implants.

Assessed the RF emission of wireless base stations.

Performed modeling and failure analyses on MEMS devices.

Evaluated the safety risk of USB-C charge cables.

Constructed optical testbench and evaluated the optical properties of ophthalmic implants according to ISO 11979-2:2014 standards.

Advisory Appointments

Technology Leaders at the Cutting Edge Seminar Series, Massachusetts Eye and Ear, Advisory Member, 2021

Peer Reviews

Scientific Reports (Nature), Optics Express (Optica), Optics Communications (Elsevier), Clinical Ophthalmology (Dove Medical Press), Sensors (MDPI)