BIOGRAPHICAL SKETCH

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NAME: Huang, David

eRA COMMONS USER NAME (credential, e.g., agency login): davidhuang

POSITION TITLE: Professor of Ophthalmology & Biomedical Engineering

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Massachusetts Institute of Technology, Cambridge, MA	B.S.	06/1985	Electrical Engineering
Massachusetts Institute of Technology, Cambridge, MA	M.S.	06/1989	Electrical Engineering
Harvard Medical School, Boston, MA	M.D.	06/1993	Medicine
Massachusetts Institute of Technology, Cambridge, MA	Ph.D.	06/1993	Medical Engineering
Mercy Hospital Medical Center, San Diego, CA	Internship	07/1994	Transitional Internship
University of Southern California, Los Angeles, CA	Residency	07/1997	Ophthalmology
Emory University, Atlanta, GA	Fellowship	07/1998	Cornea, external disease, refractive surgery

A. Personal Statement

I am an ophthalmologist, engineer, inventor, and entrepreneur. My special areas of expertise are lasers, optics, and imaging. I enjoy inventing new technologies in areas that can make major impacts in eye care. My most impactful invention has been optical coherence tomography (OCT),[1] now a commonly used ophthalmic imaging technology with an estimated 40 million procedures performed annually worldwide. It has become indispensable to the management of retinal, optic nerve, and corneal diseases. I continue to improve OCT technology and application. The most significant extension being OCT angiography, which I have worked on since 2010 and is also now widely used clinically. I have also made innovations outside of OCT. These include smartphone photography-based screening of pediatric eye conditions. I co-founded *GoCheck Kids* to market this technology, which has already been used to screen more than 5 million preschool children. Based on these innovations, I have been awarded some of the highest prizes in ophthalmology, biomedical research, and engineering. And I am one of two ophthalmologists elected to both the National Academy of Engineering and National Academy of Medicine.

Beyond diagnostic imaging, I have also ventured into the development of therapeutic interventions. The therapeutic project that is furthest along is the topic of the current proposal – laser thermal conjunctivoplasty. This project arose from my long friendship with co-investigator Dr. Steve Pflugfelder, whom I have known since my medical student days 3 decades ago. Steve and I are both cornea specialists and I have great respect for him as a leading researcher in both the basic science and clinical treatment of dry eye and conjunctivochalasis. Our collaboration started with the use of OCT to evaluate the severity of conjunctival folds and tear film disruption in patients with conjunctivochalasis. Steve is one of a few specialists who perform surgical conjunctivoplasty in high volume and taught me his technique using hot wire cautery. He was delighted when I suggested that the procedure could be more safely and quickly performed using a laser of specific wavelength applied in a precise fashion. We were even more excited when we found laser thermal conjunctivoplasty (LTC) could produce effective conjunctival shrinkage[2] and heal with minimum inflammation in animal experiments.[3] Our initial patent on the LTC technology has been allowed in the USA[4] and Europe. We were lucky to be able to recruit Dr. Scott Prahl to further improve the device. I have also known Dr. Prahl for decades because of his work in laser-tissue interaction. He is known for his expertise in modeling photon migration and heat diffusion in tissue and is well qualified to optimize the LTC device and laser parameters.

With this strong core team, I believe we are well positioned to make a big impact in the treatment of conjunctivochalasis, a very common condition associated with aging. I want to draw an analogy to cataract surgery. Prior to the introduction of modern cataract surgery technology in the 1970's, many old people put up with vision loss due to cataract because the surgery was risky, painful, and associated with long recovery and frequent complications. Today the procedure is so quick and low-risk that people in developed countries rarely tolerate more than one line of vision loss before undergoing surgery to fix the problem. We believe that with our LTC technology, the procedure would be so quick and low-risk that few people would put up with the chronic red eye, irritation, and blurry vision associated with conjunctivochalasis anymore. LTC is likely to be a high-volume surgery similar to cataract surgery, with even less disruption to daily life. We hope you will support our effort to restore comfort and function to the aging eye.

Ongoing and recently completed projects that I would like to highlight include:

NIH R01 EY023285
Huang (PI)
9/30/2013-5/31/2026
Functional and Structural Optical Coherence Tomography for Glaucoma

NIH R21 EY034330
Huang (PI)
9/1/2023-8/31/2025
Advanced transepithelial corneal collagen crosslinking

NIH R01 EY028755
Huang (PI)
4/1/2018-1/31/2023
Applications of Ultrahigh-Speed Long-Range Wide-Field OCT in Anterior Eye Diseases

Citations:

1. **Huang D**, Swanson EA, Lin CP, Schuman JS, Stinson WG, Chang W, Hee MR, Flotte T, Gregory K, Puliafito CA, Fujimoto JG. Optical Coherence Tomography. *Science.* 1991;254:1178. PMCID: PMC4638169.
2. Yang J, Chandwani R, Gopinatth V, Boyce T, Pflugfelder S, Huang D, Liu G. Near-infrared laser thermal conjunctivoplasty. Sci Rep 2018;8:3863. doi:10.1038/s41598-018-22204-0. PMCID: PMC5832782.
3. de Souza RG, **Huang D**, Prahl S, Nakhleh L, Pflugfelder SC. Comparison of Efficacy and Inflammatory Response to Thermoconjunctivoplasty Performed with Cautery or Pulsed 1460 nm Laser. International Journal of Molecular Sciences 2023; 24(6):5740. https://doi.org/10.3390/ijms24065740. PMCID: PMC10053331.
4. **Huang D**, Liu G, Yang J, Pflugfelder S. US Patent 11,896,525 B2 Laser thermal conjunctivoplasty. February 13, 2024.

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2020-present	Co-Founder and Chief Executive Officer, Unfold Therapeutic, Inc.
2020-present	Associate Director & Director of Research, Casey Eye Institute, Oregon Health & Science University (OHSU), Portland, OR
2014-2016	Member, NIH Neuroscience & Ophthalmic Imaging Technologies (NOIT) Study Section
2012-present	Founder, Chief Innovation Officer & Member of Board of Directors, Gobiquity, Inc., maker of *GoCheck Kids* smartphone photography-based product for pediatric eye disease screening.
2011-2014	Program Committee (Multidisciplinary Ophthalmic Imaging Group), Association for Research in Vision and Ophthalmology; co-chair 2013-4.

2010-present	Professor of Ophthalmology and Biomedical Engineering, Oregon Health & Science University, Portland, OR
2004-2007	Program Committee (Cornea), Association for Research in Vision and Ophthalmology; co-chair 2006-7
2004-2010	Medical Director, Doheny Laser Vision Center, University of Southern California.
2004-2010	Associate Professor of Ophthalmology and Biomedical Engineering (Tenured), University of Southern California, Los Angeles, CA
2000-2010	Ophthalmic Technology Assessment Committee, American Academy of Ophthalmology
1999-2004	Assistant Prof. of Ophthalmology and Biomed. Engineering, Ohio State Univ., Columbus, OH
1998-2004	Assoc. Staff, Cornea/Refractive Surgery, Cleveland Clinic Foundation, Cleveland, OH

Honors

2025	Elected to the National Academy of Medicine, USA
2024	American Academy of Ophthalmology Life Honor Achievement Award
2024	Association for Research in Vision & Ophthalmology Gold Fellow
2023	Lasker-DeBakey Clinical Medical Research Award, for the invention of optical coherence tomography (OCT)
2023	National Medal of Technology Innovation, USA, for the invention of OCT
2023	Elected to the National Academy of Engineering, USA
2022-present	Wold Family Endowed Chair in Ophthalmic Imaging, OHSU
2020	Visionary Award, Sanford and Susan Greenberg Prize to End Blindness
2019	Future Vision Foundation Award for the invention of OCT
2019	Top inventor in ophthalmology, the Power List, *The Ophthalmologist* magazine
2017	Nation Academy of Engineering (USA) Fritz & Dolores Russ Prize for outstanding bioengineering achievement in widespread use that improves the human condition
2017	Dr. David L. Epstein Award, Association for Research in Vision and Ophthalmology, for pursuit of the scientific understanding and cure of glaucoma
2017	Fellow, American Academy of Inventors
2013	Elected to the American Ophthalmological Society
2013	Jonas Friedenwald Award, Association for Research in Vision and Ophthalmology, for outstanding research in the basic or clinical sciences as applied to ophthalmology
2012	The Antonio Champalimaud Vision Award, the largest prize in ophthalmology and vision science, for the invention of OCT

C. Contributions to Science

1. Invention of optical coherence tomography. While an MD/PhD student at Harvard/MIT, I co-invented optical coherence tomography (OCT) with my PhD supervisor, Prof. James G. Fujimoto, and others. I was the first author of the seminal OCT paper in *Science* that has been cited more than 18,000 times. I also developed the initial concepts for polarization-sensitive OCT with Michael Hee. The MIT OCT patent US 5,321,501 covered time-domain and swept-source OCT and was the basis for clinical OCT for more than a decade. OCT is now a common imaging tool in ophthalmology with 40 million procedures performed per year worldwide.

a. **Huang D**, Swanson EA, Lin CP, Schuman JS, Stinson WG, Chang W, Hee MR, Flotte T, Gregory K, Puliafito CA, Fujimoto JG. Optical Coherence Tomography. *Science.* 1991;254:1178. PMCID: PMC4638169.
b. Hee MR, **Huang D**, Swanson EA, Fujimoto JG. Polarization sensitive low coherence reflectometer for birefringence characterization and ranging. *J Opt Soc Am B.* 1992;9:903.
c. Swanson EA, **Huang D**, Fujimoto JG, Puliafito CA, Lin CP, Schuman JS, inventors. Methods and apparatus for optical imaging with means for controlling the longitudinal range of the sample. US patent 5,321,501. June 14, 1994.
d. Hee MR, Izatt JA, Swanson EA, **Huang D**, Schuman JS, Lin CP, Puliafito CA, Fujimoto JG. Optical coherence tomography of the human retina. *Arch Ophthalmol.* 1995;113:325-332.

2. Development of anterior segment OCT. I worked with Joseph Izatt while at MIT and Cleveland Clinic on foundational aspects of corneal and anterior segment OCT, such as telecentric scanning and dewarping of image distortion caused by index transition. I have continued NIH supported research in this area for more than two decades. Significant contributions that are widely used clinically include anterior chamber and angle biometry, corneal pachymetry, epithelial thickness, and topography mapping for forme fruste keratoconus detection, measurement of corneal opacity to guide PTK, and total corneal power and astigmatism measurements for post-LASIK IOL calculation.

a. Izatt JA, Hee MR, Swanson EA, Lin CP, **Huang D**, Schuman JS, Puliafito CA, Fujimoto JG. Micrometer-scale resolution imaging of the anterior eye in vivo with optical coherence tomography. *Arch Ophthalmol.* 1994;112:1584-1589.
b. Li Y, Tan O, Brass R, Weiss JL, **Huang D**. Corneal epithelial thickness mapping by Fourier-domain optical coherence tomography in normal and keratoconic eyes. *Ophthalmology* 2012;119(12):2425-2433. PMCID: PMC3514625.
c. **Huang D**, Tang M, Wang L, Zhang X, Armour RL, Gattey DM, Lombardi LH, Koch DD. Optical coherence tomography-based corneal power measurement and intraocular lens power calculation following laser vision correction. *Trans Am Ophthalmol Soc* 2013;111:34-45. PMCID: PMC3797831.
d. Pavlatos E, Chen S, Yang Y, Wang Q, **Huang D**, Li Y. A coincident-thinning index for keratoconus identification using OCT pachymetry and epithelial thickness maps. *J Refract Surg*. 2020. 36(11): 757-765. doi: 10.1364/BOE.412209. PMCID: PMC7747916.

3. OCT-guided transepithelial phototherapeutic keratectomy. I am one of the few surgeons in the United States providing transepithelial phototherapeutic keratectomy (PTK) treatment option to patients with corneal opacities and irregularities. I pioneered the use of OCT to guide the depth of opacity removal, as well as measuring the refractive effect of epithelial masking. We have demonstrated that transepithelial excimer laser PTK can greatly improve vision and that OCT could be used to optimize ablation depth and improve refractive outcome.

a. Khurana RN, Li Y, Tang M, Lai MM, **Huang D**. High-speed optical coherence tomography of corneal opacities. *Ophthalmology*. 2007; 114(7):1278-85.
b. Cleary C, Li Y, Tang M, Samy El Gendy NM, **Huang D**. Predicting transepithelial phototherapeutic keratectomy outcomes using Fourier domain optical coherence tomography. *Cornea*. 2014; 33(3):280-7. PMCID: PMC3946298.
c. Li Y, Yokogawa H, Tang M, Chamberlain W, Zhang X, **Huang D**. Guiding flying-spot laser transepithelial phototherapeutic keractectomy with optical coherence tomography. *J Cataract Refract Surg* 2017;43:525-536. PMCID: PMC5443118

4. Glaucoma diagnostic imaging. I worked on the first computer algorithm to measure peripapillary retinal nerve fiber layer (NFL) while I was a PhD student at MIT. Later as the PI of the Advanced Imaging for Glaucoma (AIG) project, I initiated the development of macular ganglion cell complex (GCC) mapping for glaucoma diagnosis. The AIG study demonstrated that NFL, GCC, and disc parameters could be combined to improve glaucoma diagnosis and predict visual field conversion and progression. Our group developed Doppler OCT for total retinal blood flow measurement and OCT angiography to map the microcirculation of the optic disc and retina. These developments have helped make OCT the leading diagnostic imaging technology in glaucoma. We continue NIH funded research to improve the diagnosis and monitoring of glaucoma with structural OCT and OCT angiography.

a. Tan O, Chopra V, Lu ATH, Schuman JS, Ishikawa H, Wollstein G, Varma R, **Huang D**. Detection of macular ganglion cell loss in glaucoma by Fourier-domain optical coherence tomography. *Ophthalmology* 2009;116:2305-2314. PMCID: PMC2787911
b. Hwang JC, Konduru R, Zhang X, Tan O, Francis BA, Varma R, Sehi M, Greenfield DS, Sadda SR, **Huang D**. Relationship among visual field, blood flow, and neural structure measurements in glaucoma. *Invest Ophthalmol Vis Sci* 2012;53:3020-3026. PMCID: PMC3378085.
c. Loewen NA, Zhang X, Tan O, Francis BA, Greenfield DS, Schuman JS, Varma R, **Huang D**. Combining measurements from three anatomical areas for glaucoma diagnosis using Fourier-domain optical coherence tomography. *Br J Ophthalmol* 2015; 99:1224-9.
d. Liu L, Jia Y, Takusagawa HL, Pechauer AD, Edmunds B, Lombardi L, Davis E, Morrison JC, **Huang D**. Optical coherence tomography angiography of the peripapillary retina in glaucoma. *JAMA Ophthalmol* 2015; 133:1045-1052. DOI:10.1001/jamaophthalmol.2015.2225. PMCID: PMC4950955.

5. Development of clinical OCT angiography. Our research group developed an efficient OCT angiography (OCTA) algorithm called split-spectrum amplitude-decorrelation angiography (SSADA), which improved the signal-to-noise ratio of flow detection by approximately a factor of 4, without any need for additional scan time. This enabled practical angiography using standard clinical OCT systems. Unlike traditional dye-based (i.e., fluorescein) angiography, OCTA uses the intrinsic contrast of blood cell motion and requires no injection. It is also 3-dimensional, so that retinal, choroidal, and abnormal circulations can be anatomically separated. We have pioneered the use of OCTA to measure vessel density and flow index, and map areas of retinal nonperfusion, choriocapillaris nonperfusion, retinal neovascularization, and choroidal neovascularization. These disease processes are involved in the top three causes of blindness: age-related macular degeneration, glaucoma, and diabetic retinopathy. The SSADA technology led to commercial availability of OCT angiography in 2014 and its clinical use is expanding rapidly. At the 2016-2021 ARVO meetings, it was the single hottest topic in imaging. Most recently, we have developed algorithms to remove flow projection, bulk motion, and shadow artifact, which improve image quality and perfusion measurement accuracy.

a. Jia Y, Tan O, Tokayer J, Potsaid BM, Wang Y, Liu JJ, Kraus MF, Subhash H, Fujimoto JG, Hornegger J, **Huang D**. Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. *Opt Express* 2012;20:4710-4725. PMCID: PMC3381646
b. Jia Y, Bailey ST, Wilson DJ, Tan O, Klein ML, Flaxel CJ, Potsaid B, Liu JJ, Lu CD, Kraus MF, Fujimoto JG, **Huang D**. Quantitative optical coherence tomography angiography of choroidal neovascularization in age-related macular degeneration. *Ophthalmology* 2014;121:1435-44. DOI: 10.1016/j.ophtha.2014.01.034. PMCID: PMC4082740
c. Jia Y, Bailey ST, Hwang TS, McClintic SM, Gao SS, Pennesi ME, Flaxel CJ, Lauer AK, Wilson DJ, Hornegger J, Fujimoto JG, **Huang D**. Quantitative optical coherence tomography angiography of vascular abnormalities in the living human eye. *Proc Natl Acad Sci* 2015;112:E2395-E2402. PMCID: PMC4426471
d. Hormel TT, Jia Y, Jian Y, Hwang TS, Bailey ST, Pennesi ME, Wilson DJ, Morrison JC, **Huang D**. Plexus-specific retinal vascular anatomy and pathologies as seen by projection-resolved optical coherence tomographic angiography. *Prog Retin Eye Res*. 2021;80:100878. PMCID: PMC7855241.

Complete List of Published Work in MyBibliography (360 publications, 66,864 citations, H-index 100):
http://www.ncbi.nlm.nih.gov/sites/myncbi/david.huang.1/bibliography/40347588/public/?sort=date&direction=ascending