

PROMOTION RECOMMENDATION
THE UNIVERSITY OF MICHIGAN
MEDICAL SCHOOL
DEPARTMENT OF OPHTHALMOLOGY AND VISUAL SCIENCES
MEDICAL SCHOOL AND COLLEGE OF ENGINEERING
DEPARTMENT OF BIOMEDICAL ENGINEERING

Yannis M. Paulus, M.D., assistant professor of ophthalmology and visual sciences, Department of Ophthalmology and Visual Sciences, Medical School, and assistant professor of biomedical engineering, Department of Biomedical Engineering, Medical School and College of Engineering, is recommended for promotion to associate professor of ophthalmology and visual sciences, with tenure, Department of Ophthalmology and Visual Sciences, Medical School, and associate professor of biomedical engineering, without tenure, Department of Biomedical Engineering, Medical School and College of Engineering.

Academic Degrees:

M.D.	2009	Stanford University School of Medicine
A.B.	2005	Harvard University

Professional Record:

2015-present	Assistant Professor of Biomedical Engineering, University of Michigan
2015-present	Assistant Professor of Ophthalmology and Visual Sciences, University of Michigan

Summary of Evaluation:

Teaching: Dr. Paulus is a dedicated clinical and research educator, working with medical students, post-graduate students, residents, fellows, allied health providers, and health care providers from around the world. His laboratory students include those from the University of Michigan, other medical schools in and out of the state of Michigan, as well as international medical students. His teaching philosophy focuses on hands-on participation and learning, case-based discussion, and patient-oriented learning and biodesign. Dr. Paulus has taught ophthalmology residents and medical and surgical retina fellows clinical and surgical care along with retinal imaging and laser therapies. Since 2016, he has served as a guest lecturer for several Biomedical Engineering courses including BME 350, 450, 490, 499, 500, 590, and 599. Dr. Paulus has served as a clinical mentor and advisor to several teams of biomedical, medical, and business students interested in biodesign. He encourages biomedical engineering students to shadow him in the clinic and operating room to witness clinical needs that may benefit from engineering approaches. He then works with these teams of students to develop novel solutions to meet these needs, file intellectual property, and start companies to develop the technology. Multiple teams that Dr. Paulus has mentored have won the University of Michigan's BME idea competition, including iSurgery in 2017 and EnVision in 2019, which received honorable mention and third place in the national BMEidea competition, respectively. In addition to the four companies that he has started, he shares the experience of the numerous other teams that he has mentored which have resulted in ideas being brought to fruition through start-up companies.

Research: Dr. Paulus' research laboratory is a retinal imaging and laser laboratory focused on combining light and sound. Photoacoustic imaging uses nanosecond light absorption to produce ultrasound waves. The primary endogenous sources of photoacoustic signals in the eye are hemoglobin and melanin. Photoacoustics can provide both anatomic and functional information, including blood

vessel and melanin location in 3D, hemoglobin concentration, oxygen saturation, and blood flow. Many eye diseases, including macular degeneration and diabetic retinopathy, involve abnormalities in the vasculature, and thus the ability of photoacoustic imaging to visualize the vasculature can be incredibly helpful to evaluate normal and disease states. The eye is unique organ in that it is optically transparent to visible light and thus offers optical access to internal structures.

Dr. Paulus and his team have developed a sensitive, optical resolution photoacoustic microscopy system which has 4 μm lateral resolution in a large animal eye (rabbit, axial length 18.1mm). Since then, he has published several articles describing important photoacoustic imaging developments and applications of high resolution, multimodal photoacoustic microscopy, optical coherence tomography, and fluorescence microscopy imaging in normal and disease states, including retinal neovascularization, choroidal neovascularization, and retinal vein occlusion. His lab has demonstrated and patented PAM imaging using only 1% of the ANSI safety limit and developed a system to allow for simultaneous imaging with photoacoustic microscopy, optical coherence tomography, and fluorescence microscopy. His research has demonstrated that photoacoustic imaging has a particular advantage for in vivo, high resolution, 3D molecular imaging and has performed an evaluation of several molecular contrast agents for multimodal and photoacoustic imaging.

Dr. Paulus has published 119 peer-reviewed articles in leading journals such as *Nature Communications*, *ACS Nano*, *ACS Applied Materials and Interfaces*, *Experimental Eye Research*, *ACS Sensors*, *Light: Science & Applications*, the *Journal of Neuroscience*, *Biomedical Optics Express*, *JAMA Ophthalmology*, *Ophthalmology*, *Scientific Reports*, *Eye*, *Retina*, and *Investigative Ophthalmology & Visual Science* and has served as a grant reviewer for leading international organizations, including the NIH, DoD, International Retinal Research Foundation, NHS Foundation Trust in the United Kingdom, and Dutch Research council and the Netherlands Organization for Health Research and Development. He serves as the principal investigator on numerous foundation and NIH grants, including R01, K08, and R41 grants. Dr. Paulus is responsible for establishing a unique, independent research program in the field of multimodal photoacoustic molecular imaging of the retina and choroid, which has garnered international recognition in the field.

Recent and Significant Publications

Nguyen VP, Qian W, Li Y, Liu B, Aaberg M, Henry J, Zhang W, Wang X, Paulus YM: Chain-like Gold Nanoparticle Clusters for Multimodal Photoacoustic Microscopy and Optical Coherence Tomography Enhanced Molecular Imaging. *Nature Communications* 2021 Jan 4;12(1):34. PMID: 33397947 PMCID: PMC7782787

Nguyen VP, Li Y, Henry J, Zhang W, Aaberg M, Jones S, Qian T, Wang X, Paulus YM: Plasmonic gold nanostar-enhanced multimodal photoacoustic microscopy and optical coherence tomography molecular imaging to evaluate choroidal neovascularization. *ACS Sensors* 2020 Oct 23; 5(10):3070-81. PMID: 32921042. PMCID: PMC8121042

Yu G, Aaberg MT, Patel TP, Iyengar RS, Powell C, Tran A, Miranda C, Young E, Demetriou K, Devisetty L, Paulus YM: Quantification of Retinal Nonperfusion and Neovascularization with Ultrawide-Field Fluorescein Angiography in Patients with Diabetes and Associated Characteristics of Advanced Disease. *JAMA Ophthalmology* 2020 Jun 1; 138(6):680-688. PMID: 32352506. PMCID: PMC7193527

Zhang W, Li Y, Nguyen VP, Huang Z, Liu Z, Wang X, Paulus YM: High resolution, in vivo Multimodal Photoacoustic Microscopy, Optical Coherence Tomography, and Fluorescence Microscopy Imaging of Rabbit Retinal Neovascularization. *Light: Science & Applications* 2018; 7:103. PMID: 30534372. PMCID: PMC6281580

Tian C, Zhang W, Mordovanakis A, Wang X, Paulus YM. Noninvasive chorioretinal imaging in living rabbits using integrated photoacoustic microscopy and optical coherence tomography. *Optics Express* 2017 Jul 10; 25(14): 15947-55. PMID: 28789105. PMCID: PMC5557308.

Service: Dr. Paulus has actively been engaged within his professional community institutional and with broader state, regional, and international organizations. He has served on the University of Michigan Faculty Senate Assembly, Information Technology Committee from 2016-2019. Dr. Paulus has served on the departmental Steering Committee, Clinical, and Strategic Planning Retreat Think Tank. In regional and international leadership positions, he has served on the Executive Committee for the Optical Society of America Technical group on Therapeutic Laser Applications. He serves as a member of the Advanced Retinal Imaging Network, has served as the co-chair of the Annual Conference of the Michigan Society of Eye Physicians and Surgeons, Mackinac Island, MI, in 2018-2020, Fundraising Committee of the International Society for Eye Research, Finance Committee of the American Society of Retina Specialists, Young Investigator Committee of the International Society for Eye Research, and the Continuing Medical Education Committee of the Association for Research in Vision and Ophthalmology.

External Reviewers:

Reviewer A: "...As a clinician scientist, the quality of his academic work is outstanding. He has published a significant number of peer reviewed scientific articles and has also been awarded external grants that validate his research creativity. His work has been focused on the fields of retina and engineering."

Reviewer B: "...I enthusiastically support Yannis' promotion to Associate Professor at the University of Michigan. He has established a strong record of excellence in education and has contributed to our literature with his publication record. His research is novel and very productive. His extramural support demonstrates its impact. He is one of the leading [junior] investigators in ophthalmology. His record demonstrates involvement beyond his lab and is being recognized as a leader in his organizations and societies...Dr. Paulus has the qualities of a rising star. I know the University of Michigan is proud to have him on its faculty."

Reviewer C: "In addition to his profound influence in research, Dr. Paulus has served on some of the top professional societies in our field. Currently, he is a member or fellow of over 20 societies, including LIGHT The International Retinal Laser Society, and the Ophthalmology Innovation Network. Dr. Paulus serves on numerous committees, as well. Internationally, he is a member of the Fundraising Committee of the International Society for Eye Research, and the Executive Committee for the Optical Society of America Technical group on Therapeutic Laser Applications. Dr. Paulus is also a member of the Finance Committee of the American Society of Retina Specialists (ASRS). His service to ASRS, the largest retinal organization in the world, speaks tremendously of his commitment to service."

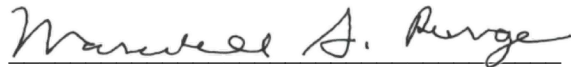
Reviewer D: "In reviewing all of his contributions, I feel he is in the top 10% of the Assistant Professors in retina. He is eminently qualified for his promotion to Associate Professor with tenure. His work in biomedical engineering is significant and qualifies him for promotion to Associate

Professor in the Department of Biomedical Engineering. His work would certainly meet the requirements for someone being considered for promotion at my institution and he would be awarded tenure at my institution.”

Reviewer E: “Yannis Paulus is a highly respected leader in his peer group working in the same field. His service contributions to the discipline are extraordinary in terms of involvement and committee work in national and international organizations, peer review of scientific journal articles and as an editor (he reviews for 26 and is an editorial board member for 7 highly respected peer-reviewed scientific journals). He is an ad hoc reviewer on NIH study sections. His teaching contributions are equally impressive.”

Summary of Recommendation:

Dr. Paulus has shown excellence and productivity in his clinical work, teaching, research, and service and is already a recognized international authority in his field. He has had great impact in biomedical engineering and ophthalmology with innovations in the treatment of diseases of the retina and vitreous. We are pleased to recommend Yannis M. Paulus, Ph.D. for promotion to associate professor of ophthalmology and visual sciences, with tenure, Department of Ophthalmology and Visual Sciences, Medical School, and associate professor of biomedical engineering, without tenure, Department of Biomedical Engineering, Medical School and College of Engineering.



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