Exploiting Deep Learning, Digital Holography, Lensless Fiber Endoscopy, and Stem-cell-derived Organoids for Paradigm Shifts in Biomedicine

Professor Jürgen Czarske

TU Dresden, Professor for Metrology, Czarske Lab,
Director of Center Biomedical Computation Laser Systems

Speaker Bio:

Jürgen Czarske (Fellow EOS, OPTICA, SPIE, IET, IOP, Senior Member IEEE) is director, full chair professor and senator of the Excellence University TU Dresden, Germany. He is director of Competence Center Biomedical Computational Laser Systems (BIOLAS) and advisor of SPIE-OPTICA-Student Chapter Dresden. Jürgen is an international prize-winning inventor of laser-based technologies. His awards include the 2008 Berthold Leibinger Innovation Prize, 2019 OPTICA Joseph-Fraunhofer-Award/Robert-M.-Burley-Prize, 2020 Laser Instrumentation Award of IEEE Photonics Society, 2020 and 2021 SPIE Community Champion for volunteer activities, and 2022 SPIE Chandra S Vikram Award. Juergen has conducted more than 800 talks and papers, including more than 250 papers in peer-reviewed journals, over 150 invited talks and over 30 patents. He is Vice President of International Commission for Optics, ICO, and was the general chair of the world congress ICO-25-OWLS-16-Dresden-Germany-2022 with 3 Nobel laureates and participants from over 55 countries.

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Abstract:

Light has the potential to recognize the origins of diseases, enabling to prevent them, or to cure them early and gently. The early diagnosis is the key to improve the survival rate and cure rate of patients. We highlight two research topics.

Endoscopy plays an important role in the early stages of diagnosis by guiding biopsy. Conventionally, it takes several hours to a few days for the surgeon to know the results of the diagnosis. Optical biopsy (histopathology) offers real-time intraoperative diagnosis. The paradigm-shift of lensless fiber endoscopy is highlighted for virtual staining. We demonstrate an end-to-end lensless fiber imaging using deep neural networks. The well-trained resolution enhancement network helps improving tumor recognition rate. It is promising for minimally invasive intraoperative treatment of cancer in neurosurgery.

Advanced manufacturing of retinal organoid samples from human induced pluripotent stem cells represents a promising way to study the development of retinal diseases. We study the capability of the optical transmission matrix, measured by digital holography for retinal organoid tissues. Inducing of age-related macular degeneration (AMD) results in distinct changes of the transmission matrix. The promising development of imaging-based biomarkers for the human retina is discussed.

Location: 414 CEPSR, Sign Up @ https://forms.gle/uKdLfPwYUMUZYjtN9

Date: October 21st, 2022

Time: 9:30 am - 11:00 am EST

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