Tomasz Tkaczyk, Rice University, USA

Bio:

Tomasz Tkaczyk specializes in the development of modern optical instruments that combine advanced technologies in optics, opto-mechanics, electronics, and materials to engineer novel imaging instruments, multi-dimensional snapshot imaging modalities, and systems for the early detection and treatment of diseases.

Tkaczyk's basic, applied, and translational research is leading to the development of new imaging technologies that are compact, robust, portable, inexpensive, and adaptable to mass production. The compact size of his high-performance imaging systems makes them ideal for point-of-care diagnostics in various clinical settings around the world. Biomedical applications have included in-vivo molecular imaging of precancer and cancer; multiplexed cell signaling analysis; and imaging systems to guide therapy and aid in surgical resection of the oral cavity, esophagus, and lung, and in the early screening and treatment of macular degeneration, diabetic retinopathy, and tuberculosis.

Tkaczyk is the principal investigator on an NIH R01 research project to build and test an advanced dualfunctioning medical instrument called the Bi-FOV Endoscope. The five-year investigator-initiated project involves several institutions and three subcontractors for the development of an integrated optical needle that works with contrast agents to provide real-time cancer detection. The endoscope is part of another ongoing project in which Tkaczyk serves as a co-principal investigator in the fabrication and testing of optical and mechanical technologies, such as miniaturized optics, micro-electromechanical system (MEMS) components, and low-cost/high performance and modern-fabrication technologies. The joint efforts with collaborators at Rice University and the University of Arizona have enabled new platform technologies or methods not possible five or even ten years ago, and are currently in clinical trials.

Through the support of an NIH R21 grant, Tkaczyk developed an imaging technique called Image Mapping Spectrometry (IMS) that uses a specialized compact camera and couples with any high-resolution microscope, endoscope, or camera system to see a biological sample's chemical and physical composition. The technology has the potential of becoming a fundamental research tool for microscopy and has many medical and lifescience applications. A patent application for the IMS was submitted, and the Optical Society of America featured the IMS in its "2010 Papers of the Year."

A new collaborative research focus in the Tkaczyk laboratory, which is supported by a $2 million grant by NASA's Science Mission Directorate, involves the development of a small, sophisticated snapshot spectrometer to analyze Earth's atmospheric and surface conditions from algae blooms and other contaminants in coastal waters.

Presentation Title:

Paradigm shifts in biomedical and diagnostic imaging

Abstract:

The talk is a discussion of rapid development of paradigm shifts in area of biomedical imaging, diagnostics and detection. The main goal is to initiate/spur discussion about where the biomedical imaging / detection field

may transition as we witness increasing participation of digital and computational imaging, active imaging systems adapting to imaging conditions, new fabrication techniques, novel materials (including bio-compatible systems for implants), and new signal sources spanning from novel laser sources, to new fluorescence contrast or bio-luminescence. While the range of mentioned topics is vast, selected specific aspects will be discussed including: (a) imaging devices and computational imaging separately or in combination: impact on design, performance and imaging process; (b) new fabrication methods and materials allowing exotic ideas (new functionality, custom implementations, prototyping in one process); and (c) possible pathways to future of in-vivo monitoring (active detection implants etc.). Examples of recent fabrication methods, applications of miniature systems, and multi-dimensional imaging modalities will be presented to support discussion.