SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

BIO-INSPIRED MULTI-SPECTRAL IMAGE SENSOR AND AUGMENTED REALITY DISPLAY FOR NEAR-INFRARED FLUORESCENCE IMAGE-GUIDED SURGERY

DISSERTATION DEFENSE
By

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Abstract: Near-infrared (NIR) fluorescence image-guided surgery (IGS) is a medical technique that provides critical structural and functional tissue or organ information to the surgeon in clinical settings to successfully detect and differentiate tumor tissue from surrounding healthy tissue. Current state-of-the-art NIR imaging systems have two major shortcomings. First, they are unable to capture NIR fluorescence information under surgical light illumination due to high dynamic range requirements. Second, the combined NIR and color information is presented either on a monitor or video-display goggles. The natural vision of the surgeon is replaced with virtual information from the color and NIR sensors. In my thesis, I addressed these shortcomings by developing a multi-exposure image sensor, a time domain image sensor and a photovoltaic mode logarithmic sensor with filters capable of simultaneously capturing color and NIR images under a surgical light source. The photo response and filter structure mimic the mechanisms of butterfly retina and tapetal filters. I also investigated augmented reality display systems that can be used to present the NIR information without blocking the natural vision of the surgeon using Microsoft HoloLens, which allows the user to see an augmented image on a transparent display component of the goggles. An optical setup and algorithm were developed to co-register human natural vision, tumor and augmented NIR fluorescence images. Pre-clinical trials with small animal models demonstrated the use of a bio-inspired CMOS multi-spectral imaging system and the augmented reality display system. Due to enhanced performance and user experience, the bio-inspired sensors and augmented reality display system will give medical care providers much needed technology to enable more accurate value-based healthcare.

DATE: **Tuesday, April 24, 2018**
TIME: **1:00 p.m.**
PLACE: **Green Hall, Room 0120**

Dissertation advisors:
Dr. Shantanu Chakrabartty
Dr. Viktor Gruev

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
SCHOOL OF ENGINEERING & APPLIED SCIENCE