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

PhD Preliminary Research Examination

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Abstract: Near-infrared (NIR) fluorescence image-guided surgery (IGS) is a medical technique that can provide 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 cannot capture NIR fluorescence information under surgical light illumination due to the high dynamic range requirements. Second, the combined NIR and color information is presented either on a monitor or video-display goggles. The surgeon's natural vision is replaced with virtual information comprised by the color and NIR sensor. To address these shortcomings, I have successfully developed a multi-exposure image sensor with optical filters that capable of capturing both color and NIR image at the same time under surgical light source. However, the result reveals two major problems: 1) the dynamic range (DR) of the scene in the operating room (easily exceed 120 dB) cannot be detected and the signal-to-noise ratio (SNR) of low intensity object is lowed, caused by the read-out scheme of traditional voltage mode active pixel sensor (APS). 2) both the color and NIR fluorescence image are still displayed on a computer monitor. To address these shortcomings, I propose to investigate the realization of a bio-inspired, multi-spectral imager using time domain imaging. It will mimic the mechanism of butterfly's eye and retina, producing uniformly high SNR and high DR. I will also investigate augmented reality display system that can present the NIR information without blocking the surgeon's natural vision using Microsoft Hololens®, which allows the user to see the augmented image on the goggle transparent display component. One of the challenges is to co-register the NIR fluorescence augmented image with the actual target. I will develop an optical setup and algorithm to co-register the human natural vision, tumor and the augmented NIR fluorescence image. Finally, I will demonstrate the use of the bio-inspired CMOS multi-spectral imaging system and augmented reality display system in a small animal models and in clinical settings.

DATE: Thursday, May 4, 2017
TIME: 1:30 p.m.
PLACE: Green Hall, Room 0120

Dissertation advisor:
Dr. Shantanu Chakrabartty

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

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