REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-24-02

Utilizing High Speed Imaging to Directly Visualize Directed Energy Interactions with Biological Systems

PROJECT DESCRIPTION: Directly visualizing directed energy interactions with tissues and cells can be quite challenging, particularly for short electromagnetic or optical exposures with durations shorter than 1 microsecond. Many optical based techniques can provide high resolution imagery of the interactions, but lack in temporal resolution when tasked with visualizing the dynamics occurring during an exposure. This is primarily due to limitations on image sensor read rates, and the need for longer integration times to collect sufficient signal to accurately resolve a response. My research group is focused on developing advanced imaging and microscopy techniques to understand the fundamental mechanisms of directed energy interactions. Current research projects include developing novel ultrafast imaging to visualize pulse laser ablation dynamics; utilizing advanced microscopy techniques such as stream camera- and optical streaking-microscopy to visualize cellular responses to pulsed electric field stimulation to elucidate fundamental mechanisms; and studying the mechanisms of infrared laser interactions with neurons and excitable cells. This project will provide students the opportunity to learn about ultrafast imaging, design and construct optical imaging systems, conduct biophysics experiments, and gain expertise with cell culture and imaging of biological systems using fluorescent dyes or other indicators. Student interns will also have the opportunity to learn how to operate commercial microscopes including confocal, multi-photon, and total internal reflectance microscopes.

ACADEMIC LEVEL: Undergraduate; Masters; Doctoral

DISCIPLINE NEEDED:
- Physics
- Biomedical Engineering
- Biology

RESEARCH LOCATION: JBSA-Fort Sam Houston, San Antonio, Texas

RESEARCH MENTOR: Joel N. Bixler, PhD
Biomedical Engineering, Texas A&M University, 2015

Joel Bixler is a Senior Research Biomedical Engineer in the Optical Radiation Branch at the Air Force Research Laboratory, Human Effectiveness Directorate. He joined AFRL in 2014 as a Pathways student, and currently serves as a principal investigator on projects studying laser tissue interactions using ultrafast imaging systems. This includes efforts to visualize tissue optical properties and an AFOSR funded grant developing novel imaging tools to study pulsed laser ablation. Dr. Bixler's research group also focuses on developing machine learning based image processing tools and compressed optical sensing-based methods for visualizing bioelectromagnetic interactions. Dr. Bixler has published over 30 peer reviewed publications and is a leader within the SPIE international society. *Photo courtesy of the U.S. Air Force Research Laboratory.*