REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-26-03

Anatomical Finite Element Modeling of Laser Tissue Interactions

PROJECT DESCRIPTION: Understanding the dynamics of laser tissue interaction is crucial for protecting military personnel and advancing DoD warfighting capabilities. Computational modeling offers a powerful research avenue for predicting optical bioeffects, but the model accuracy relies on high-fidelity anatomical representations and experimentations. This project will leverage high-fidelity anatomical meshes to enhance in-house finite element codes that model these complex laser tissue exposures, which involve nonlinear thermodynamics and tensor mechanics. The research goal is to develop accurate tissue meshes and apply existing multiphysics solvers to evaluate heat transfer and damage, directly contributing to the DoD's Modeling, Simulation, and Analysis (MS&A) capabilities within the Optical Radiation Bioeffects Branch.

LEARNING OBJECTIVES: The participant will gain experience in computational biophysics, laser material interaction physics, engineering mesh design, and multiphysics modeling. Familiarity with Linux, Python, and C/C++ is not required, but could be advantageous.

ACADEMIC LEVEL: Undergraduate**;** Masters; Doctoral

DISCIPLINES NEEDED: Applied Physics, Optics, Computational Mathematics

RESEARCH LOCATION: JBSA Fort Sam Houston, Texas

RESEARCH MENTOR: Steven Cavazos, Ph.D.
Physics, University of Texas, San Antonio, 2024

Dr. Steven Jay Cavazos is a Research Physicist with the AFRL 711th Human Performance Wing in the Optical Radiation Bioeffects Branch at Fort Sam Houston, Texas. Leveraging his experience from national laboratories, he has expertise in both experimental and computational methods, with a background in nuclear fuels in extreme environments and mutiphysics computational modeling of fissionable materials. After graduating with his Ph.D. in Physics in 2024, he transitioned from nuclear fuel performance to human performance, with interests in high energy lasers, nonlinear dynamics, and advanced material characterization methods.

Photo Courtesy of the Air Force Research Laboratory

The material was CLEARED on 10 Dec 2025; Reference Number: AFRL-2025-5591.