

REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-21-08

ADVANCED SKIN MODELS FOR GHz EXPOSURE ANALYSIS

PROJECT DESCRIPTION: The Bioeffects Division (RHD) of the Air Force Research Laboratory (AFRL) performs research to characterize the biological effects of Directed Energy (DE) exposures. Typically, the DE exposures considered are propagating laser and radio frequency (RF) energies. While the biological effects of these energies at the cellular to tissue level can be studied in the laboratory, these efforts are time and labor intensive, and often lack suitable measurement precision to fully establish dose-response curves. As a complimentary research activity, computational modeling and simulation (M&S) approaches have been used to provide detailed dosimetric data.

In the 6-300 GHz band of the RF spectrum, energy is absorbed superficially in the skin and subcutaneous tissues. Therefore, M&S approaches have been adopted that assume a layered tissue slab model, where the layers commonly include the epidermis, dermis, fat, and underlying muscle. However, these models ignore certain features within the skin, such as sweat glands, that could have a significant impact on localized RF absorption patterns and therefore transient thermal solutions. This research project seeks to develop more sophisticated CAD-like models of human skin that can be used within existing M&S software. This approach will then be used to study the sensitivity of simulation outcomes to various types of embedded skin structures.

ACADEMIC LEVEL: Bachelors, Masters, PhD

DISCIPLINE NEEDED:

- Computer, Information, and Data Sciences
 - Computer Science (general)
 - Data Science
 - Graphics and Visualization
 - Scientific Computing and Informatics
 - Software Engineering
- Engineering
 - Bioengineering and Biomedical Engineering
 - Electrical and Electronic Engineering
 - Engineering Physics
 - Radiation Protection
- Mathematics and Statistics
 - Applied Mathematics
- Physics
 - Acoustics
 - Applied Physics
 - Optics
 - Physics (General)
 - Theoretical Physics

RESEARCH LOCATION: JBSA, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Jason Payne, ME
Electrical Engineering, Texas A&M University

Mr. Jason Payne is a Senior Research Biomedical Engineer at the Air Force Research Laboratory (AFRL) and the Core Research Area lead for Directed Energy Modeling, Simulation and Analysis. His research has focused on computational modeling of radio frequency (RF) bioeffects, with a special emphasis on finite-difference solutions for Maxwell's equations and the bioheat equation. This research is instrumental in assessing the consistency of RF safety standards, and characterizing the dose-response relationship between RF exposures and observed biological effects.