REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-26-02

Development of an electronic speckle pattern interferometer (ESPI) for standoff measurement of displacement of materials within high-power radiofrequency (RF) electromagnetic environments

PROJECT DESCRIPTION: Human health and safety standards concerning exposure to radiofrequency (RF) electromagnetic energy are based on the collective knowledge of the biological effects of exposure. These standards are important for ensuring the safety of civilians who live with constant, low-power exposure to RF electromagnetic energy stemming from modern electronics and information systems, and for personnel who must work within higher power RF electromagnetic fields occupationally (e.g., working on cell phone towers or near powerful radar systems). To fully understand the biological effects of exposure, experiments must be conducted in which the exposure conditions are controlled, measurable via dosimetry, and agree with physics-based calculations; additionally, the effects of the exposure on biological materials must be precisely and accurately measured using tools that are non-perturbing to both the electromagnetic field and the material under test.

The Air Force Research Laboratory's Radio Frequency Bioeffects Branch is interested in advancing the development of a tool, an electronic speckle pattern interferometer (ESPI), designed for micrometer-scale measurements of the displacement of materials, particularly biological materials, during exposure to high-power radiofrequency (RF) electromagnetic fields. The tool is non-perturbing, as measurements can be taken from a large standoff distance, far outside the RF beamline and does not alter the material under test. Measurements of the micrometer-scale displacement of materials exposed to high-power RF electromagnetic fields is extremely challenging, as high-power electromagnetic fields can cause electromagnetic interference (EMI), electrical breakdown and arcing, and damage to nearby electronics. The ESPI is used to probe the biophysical interactions and effects of high-power RF on biological materials, and is used to advance our knowledge of the mechanisms leading to pathophysiological responses that affect human health and safety.

We seek an interdisciplinary research intern, preferably a physics or engineering student with education and/or experience in optics, to participate in the development of our ESPI to improve and increase its measurement capabilities for use in RF bioeffects research.

LEARNING OBJECTIVES: Selectee will develop an understanding of optical engineering and how to safely and methodically develop an optical apparatus utilizing various optical components (e.g., a laser, cameras, mirrors, beam splitters, fiber optics, lenses, motorized stages, etc.) and specialized software for synchronized device control, data acquisition, and data analyses (e.g., LabVIEW and MATLAB), and learn about radio frequency (RF) bioeffects.

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

DISCIPLINES NEEDED: Physics (General), Engineering (General), Optics

RESEARCH LOCATION: Fort Sam Houston, Texas

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

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RESEARCH MENTOR: Jennie Burns, Ph.D.
Biomedical Engineering, Tulane University, 2012

Dr. Burns is a Research Biomedical Engineer with the Radio Frequency Bioeffects Branch of the 711th Human Performance Wing, Air Force Research Laboratory. Dr. Burns has 19 years of experimental research experience in a diverse range of scientific disciplines that include experimental high energy particle physics, computational modeling in biophysics and biomechanics, microfabrication, biomedical device development, microscopy, physiology, signal processing, bio-electromagnetics, optical engineering, neuroscience, electrophysiology, and medical imaging. Currently, she serves as the principal investigator on experimental research projects focusing on the biological and physiological effects of the absorption of radio frequency (RF) electromagnetic energy in complex biological systems. The research helps elucidate the RF dose-response relationship and characterize the health and safety implications of RF exposure.

Photo Courtesy of the Air Force Research Laboratory

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