

AEROSPACE ENGINEERING AND ENGINEERING MECHANICS  
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE WOMEN

FOR APPLICATION YEAR: 2021

PROJECT TITLE: Advanced High-Speed Imaging in High Temperature Flows

Daniel Cuppoletti  
462 Engineering Research Center  
Cincinnati, OH 45221  
cuppoldr@ucmail.uc.edu  
Phone: 513-604-1297

**Project Description**

Optical measurements of aerodynamic flows provides a means for engineers to visualize the invisible. The advent of high-speed cameras, faster and more powerful lasers, and advances in computing power and data storage has resulted in imaging diagnostics that are capable of very high spatial (space) and temporal (time) measurements. Fluid dynamics researchers utilize these imaging diagnostics to study the physics of high-speed and high-temperature flows to advance aerospace designs for greater efficiency and performance. Advanced aircraft concepts are moving towards further integrating the airframe and propulsion system to achieve greater aerodynamic efficiency, reduced fuel burn, and reduced aircraft noise. This trend toward close integration of the propulsion system with the airframe is resulting in new challenges as the complex aerodynamic flows interact with the airframe surface.

This project will involve utilizing imaging diagnostics including Particle Image Velocimetry (PIV) to measure gas velocity and Infrared Imaging Spectroscopy to measure surface temperatures for a high-velocity, high-temperature gas flow interacting with a surface. These measurements will use high-speed cameras capable of kilohertz acquisition rates, meaning thousands of frames per second. This will allow us temporally resolve these unsteady processes due to turbulence fluctuations in the high-speed flows. The unique aspect of this project will be to develop new methods for acquiring simultaneous velocity and temperature from these measurement techniques. The ability to understand these short timescale processes will have major implications in the design of future aerospace vehicle systems with closely integrated propulsion systems.