PROJECT TITLE: Full Field Shear Stress Measurements using Liquid Crystals in Hypersonic Flows

Physical Requirement : Must lift 30 lbs
Project's Technical Skills Requirement : See project description

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Project Description

Hypersonic vehicle design is dependent on understanding not only the vehicle payload and its propulsive power requirements, but also on the aerodynamic forces that have to be overcome, especially the drag force. Over 50% of the drag of a hypersonic vehicle is attributed to skin friction and the shear stresses that are derived from this force. These shear stresses not only affect the force and moment coefficients but also impact the aerodynamics of control surfaces, protuberances, and cavities, as well as loading around fin/body junctions. The goal of this R&D effort is to develop a technique to non-intrusively measure the shear stress distribution over a vehicle surface simultaneously. This is being achieved using Shear Stress Sensitive Liquid Crystals (SSSLC). This R&D effort is being funded by the Naval Office of Research and all R&D activities will take place at the Prime Contractors facility, Engineering & Scientific Innovations, located in Fairfield Ohio which is approximately 20 minutes from UC.

To this end Two Undergraduate Research Co-op Fellowships are being offered for the Fall 2022 semester. The following fellowship opportunities are separated into a predominately hardware or software R&D effort:

1) High Speed Flow Facility Development:
Participation in the development, fabrication, and documentation of two high speed facilities, a M = 4 supersonic facility and M = 5 hypersonic flow facility, as well as the development of a SSSLC calibration rig.

Preferred Skills include:
• Experience with fluid mechanics and heat transfer, knowledge of
compressible flow a plus.
• Some knowledge of measurement techniques.
• Ability to perform experiments.

2) Object Identification and Locating using AI:
Development of an image identification and locating algorithm using Artificial Intelligence (AI). This effort involves the simultaneous acquisition and analysis of several dynamically changing objects. For test purposes small flames, which must be geometrically sized and spatially located in real time would be used.

Preferred Skills include:
• Experience in programming a Raspberry Pi microprocessor.
• Ability to understand and work with AI algorithms.