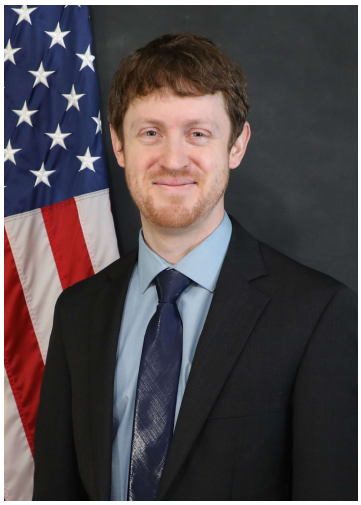
COLLEGE OF
Engineering, Computer Science, and Technology

Seminar in Interdisciplinary STEM Research

January 29th – Thursday, 3:05-4:20 PM PST

Location: E&T C256

HOSTED BY CREST-CATSUS AND SIKAND SITI CENTERS



Matthew Boston, Ph.D.

Research Engineer at Aero Vironment Inc.

Matt Boston is a Research Engineer at AeroVironment, Inc. working as a post-doctoral researcher at the Air Force Research Laboratory since Fall 2023. He obtained a B.S. in Mechanical Engineering from Oregon State University and in Materials Science from Saarland University in Germany. He began his graduate studies in Aeronautical and Astronautical Engineering in 2016 at Purdue University, getting an M.S. in 2018 and Ph.D. in 2023. His graduate work was conducted in the Programmable Structures Laboratory under Prof. Andres Arrieta in the areas of aeroelasticity and adaptable structures, with an emphasis on how multistable structures and cellular materials can enable morphing wings. His current research interests include topology optimization for adaptable structures and modelling fluid-structure interaction and aeroelasticity.

Modeling Fluid-Structure Interactions for Physical Reservoir Computing

Increasingly sophisticated modern flight systems demand greater computational power for tasks such as real-time control, navigation, and sensor processing. This need is particularly relevant for systems that leverage adaptive structures and localized fluid dynamics to optimize performance characteristics. Increased degrees of freedom and complex fluid-structure interactions leave such systems susceptible to aeroelastic phenomena. Detecting and controlling such phenomena requires complex models or many sensors, with additional computational power needed to process data streams in real-time. Alternative computational architectures have been proposed seeking to address these challenges. Physical reservoir computers (PRCs) are an example architecture which leverages the intrinsic dynamics of a physical system to perform computational tasks. A PRC projects an input signal to a high-dimensional, nonlinear space, allowing a nonlinear output function to be mapped from the input by training a linear readout layer. For an effective mapping, the physical reservoir needs nonlinearities enhancing the system's dynamic complexity. Structural and fluid domains have each been investigated as suitable media for PRCs. The fluid domain is a source of rich dynamic complexity but often lacks stability in high Reynolds number regimes. The structural domain is conversely often simple but can be made stable across a wide regime of conditions. Combining the two domains through fluid-structure interaction (FSI) opens the design space significantly to search for potential reservoirs that leverage the benefits of their respective physics. This talk will introduce the concepts of physical reservoir computing and modelling fluid structure interaction. A reduced-order model of an airfoil in a flow will then be used to demonstrate the use of a fluid-structure physical reservoir computer in an application-relevant task.

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