PennState College of Engineering | AEROSPACE ENGINEERING

SEMINAR SERIES

Monique McClain

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Wednesday, November 13th

4:40-5:30 pm | 220 Hammond Building

ADDITIVE MANUFACTURING OF VISCOUS MATERIALS: DEVELOPMENT AND CHARACTERIZATION OF 3D PRINTED ENERGETIC AND COMPOSITE STRUCTURES

ABSTRACT

Solid rocket motors have been designed, tested, and characterized reasonably well since the 1960's and have been used for a variety of applications, such as space shuttle boosters and missiles. The performance of several parts in a solid rocket motor, such as the propellant grain and the nozzle, are highly dependent on geometry and structural/ thermal properties. Traditional manufacturing processes for creating solid propellant grains and ablative nozzles can limit performance, since it is very difficult, or sometimes impossible, to create multi-material components with fine features. Additive manufacturing (AM), which has been used for many aerospace applications, can potentially be used to make multimaterial structures with intricate geometries. This could allow the creation of new propellant grains and nozzle designs which can allow improved optimization of a rocket motor for a specific mission. In general, commercial AM methods have not been able to 3D print high performance propellant or composite mixtures since they are extremely viscous materials. In this talk, I will highlight a new AM method called vibration assisted printing (VAP) which has been used to directly 3D print solid propellant and carbon fiber/polymer mixtures. I will also discuss how this manufacturing method allows the aerospace community the opportunity to investigate how new geometries and material gradients could be used to tailor the performance of solid rocket motors in ways that have never been done before. This work can also expand the capabilities of 3D printing with application to CubeSATs, satellite control systems, and small rockets to allow for rapid prototyping and production, as well as reduce costs compared to integrating more complex propulsion systems that require more thermal management, plumbing, or more electrical power.

BIO

Monique McClain is a graduate research assistant with a background in propulsion and additive manufacturing who works at Maurice J. Zucrow Laboratories at Purdue University. In 2018, she received her M.S. from the School of Aeronautics and Astronautics from Purdue University and she received her B.S. in Aerospace Engineering from the University of California, San Diego in 2016. She is currently pursuing her Ph.D. and her main research focus is to develop and apply new additive manufacturing technologies to create geometrically intricate, multi-material solid propellant grains and functionalized ceramic parts. In addition, she has worked on other propulsion related projects, such as developing novel hybrid propellant grains and investigating combustion instabilities in combustors.

Please join us for refreshments before the seminar, at 4:15pm in the Aero Cafe (225 Hammond).