2018 SVC Research Seed Program Announcement

We are pleased to announce that 4 proposals have been selected for funding through the 2018 SVC Research Seed Program. These awards total $60,000 in internal research funding to 4 MAE investigators. Each awardee received $15,000 available as discretionary university funds. This seed program aims to stimulate research collaborations between researchers and industry to the point where a compelling proposal can be developed to attract memberships to SVC, while supporting PhD students and promoting citizenship within SVC by participating faculty and students. The initial funding period is May 1, 2018 to April 30, 2019, with the continuation of the Program into year 2 being contingent on the availability of funds and progress made in year 1.

Consistent with the NSF IUCRC Program (nsf.gov/eng/iip/iucrc/), SVC conducts industry-relevant, pre-competitive research via multi-member, sustained industry-university partnerships. SVC's mission is as follows: (1) conduct basic and applied research on smart materials and advanced technologies applied to ground and aerospace vehicles; (2) build an unmatched base of research, engineering education, and technology transfer with emphasis on improved vehicle performance, unprecedented safety improvements, and enhanced vehicle efficiency, and; (3) prepare next-generation engineers at the PhD and MS levels who possess both theoretical and experimental expertise applicable to automotive and aerospace vehicles.

2018 SVC Research Seed Program Awards:

Solution Processing of Thermochromic Vanadium Dioxide Smart Windows

Principal Investigator: Vicky Doan-Nguyen, Joint appointment in Materials Science and Engineering and Mechanical and Aerospace Engineering

Vanadium dioxide (VO2) can be tuned chemically to control its thermochromic, optical response. Film deposition and regulation of phase purity is key to use of VO2 and doped VO2 in smart windows applications. We propose solution processable deposition heat treatments to rapidly produce VO2-based thin films. The proposed work will provide foundational understanding for controlling the metal-insulator transition in VO2 and doped-VO2. Additionally, optimization of deposition and annealing conditions will produce a scalable methodology for smart windows applications. We anticipate this work will lay the foundation for investigating less expensive transition metal oxides (e.g. NbO2) with higher switching temperature range (~900ºC). The work in this Smart Vehicle Concepts Center seed grant proposal will allow us to pursue funding opportunities with industry. Our work smart windows coating technology complements the existing SVC projects as well as provide an additional solution for efficient in temperature regulation. As members of SVC conduct industrially-relevant, pre-competitive work, we will work with industry partners to reduce materials cost (e.g. reduce film thickness, stoichiometric ratios) while maintaining performance.

Isolation Strategies for Electrified Vehicle Powertrains over a Broad Range of Frequencies

Principal Investigator: Luke Fredette, Mechanical and Aerospace Engineering

The proposed project is an investigation of new powertrain (PT) mounting techniques with a focus on high-frequency isolation and motion control for electrified vehicles (EV). System-level behavior will be analyzed to determine appropriate mounting configurations, and component-level isolator dynamics evaluated to achieve both improved vibration isolation and motion control design needs over a wide range of frequencies. Expected outcomes include new EV powertrain models, design paradigms for EV isolation and motion control, as well as new sponsor engagement. Dynamic performance considerations related to powertrain mounting for electrified vehicles is of stated interest to several SVC member organizations, especially as EV technology becomes more widespread in US and global markets. The proposed project should provide research tools and insights which benefit OEMs and suppliers, as well as expanding research access by bringing in new membership(s).

Integrated Hyperdamping Material Systems for Vibration, Noise, and Shock Attenuation Applications

Principal Investigator: Ryan L. Harne, Mechanical and Aerospace Engineering

Attenuating vibration and shock from the multitude of vehicle components is essential to promote occupant safety, comfort, and satisfaction. The energies that are left unabated become a further nuisance as radiated noise into vehicle cabins. These are historical noise-vibration-harshness (NVH) challenges that face original equipment manufacturers (OEMs) throughout the automotive and aerospace industries. The PI has recently led efforts to devise lightweight, hyperdamping material systems that leverage compression upon cellular void patterns to magnify energy dissipation properties for vibration and shock mitigation. The outcomes reveal significant means to attenuate vibration and shock, and hence suppress radiated noise, while using less mass than benchmark approaches to resolve such concerns. In the studies to date, the material systems considered have been developed for laboratory purposes, so that no specific application is in mind towards the formulation of the material geometries. Despite the baseline of research, no efforts have been made that seamlessly integrate the hyperdamping materials into practical applications. This work will achieve such integration to test the efficacy of the material systems in realistic operating environments.

'Seeing' the temperature inside a 3D printed part

Principal Investigator: David Hoelzle, Mechanical and Aerospace Engineering

Powder Bed Fusion (PBF) is an Additive Manufacturing (AM, also termed 3D printing) process for making complex architecture, light-weight, metal structures. The objective of the proposed research is to define a temperature observer to estimate internal temperature states during PBF manufacture. An observer is a sensor filter that merges data and a process model to estimate internal states of a system (such as temperature) that are not measureable. Our team has built the first, simplified observer for the Metal PBF process; the observer merges finite element (FE) based thermal solvers with a Kalman filter and has been validated in a simplified simulation environment. The project seeks to significantly expand upon this work. We will: 1) build an observer package to allow PBF practitioners to 'see' temperature fields inside a part, and 2) validate the theory and package in PBF builds. The expected research outcomes are: 1) the delivery of a general temperature observer engine that integrates part geometry, process parameters, and material properties; and 2) a validation set that will yield a deeper understanding of the practical aspects of temperature observation, such as signal noise and model uncertainty, which challenge observer performance, and the definition of an experiment that will set the standard for future developments by other researchers.