SYMPOSIUM

School of Aeronautics and Astronautics

The 2014 Research Symposium Series

* Free Pizza *

Wednesday, April 23, 2014

4:30 pm in ARMS 1021

Multifunctional EV Battery Systems

Waterloo Tsutsui

We are currently developing electrical vehicle (EV) battery packs, funded by ARPA-E RANGE program, that can substantially reduce the impact shock to the occupants in a ground vehicle getting into crash loading conditions. This battery system has three functions: a) stores electricity during the normal operation of an EV, b) protects the battery by controlling the stress transmitted to the battery, and c) aids in absorbing/dissipating impact energy during a traffic collision in order to reduce the risk of bodily injury to the occupants. To achieve combined management of stress and energy absorption/dissipation capabilities, our research focuses on two potential systems based on two pending patents: Granular Battery Assembly (GBA) and Topologically Interlocked Battery Assembly (TIBA). In GBA, each battery cell is surrounded by dummy cells that reduce the load propagation at its particle velocity, rather than at the shock wave speed; thus, GBA functions as a kinetic energy dissipation device. In TIBA, the major part of kinetic energy based on the impact is dissipated by the friction between the TIBA unit cells that are interlocked to each other. The interlocked TIBA unit cells create the battery pack structure by themselves without the need for adhesives.

Multi-Objective Optimization Of Fleet-Level Metrics To Determine New System Design Requirements: An Application To Military Air Cargo Fuel Efficiency

Parithi Govindaraju

The design requirements assigned to yet-to-be-acquired military systems, when those systems are to operate alongside existing systems, impact the mission capabilities available to and performance of the resulting system of systems. The problem of identifying these design requirements for new, yet-to-be introduced systems is very challenging due to the tight coupling of the system design problem (here, a new aircraft design) and the resource allocation problem (here, aircraft fleet deployment to provide military cargo transportation), and quantifying their impact on fleet level metrics. Our proposed research seeks to address the complexities in solving a combined platform design, fleet operations and acquisition-level decision making problem by utilizing the design requirements of a new system (or systems) as design variables in an optimization problem formulation. We employ a decomposition approach that provides a process to determine the design requirements of a new platform that improves fleet-level performance; this fleet-level performance usually involves multiple, competing fleet-level objectives. The proposed research will investigate tradeoffs between objectives of fuel usage and fleet-wide productivity for the USAF Air Mobility Command cargo-carrying fleet. The research will also investigate the potential for fleet fuel savings via possibly non-intuitive requirements for the new aircraft.

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