SYMPOSIUM

School of Aeronautics and Astronautics

The 2014 Research Symposium Series

*** Free Pizza ***

Monday, April 21, 2014

4:30 pm in ARMS 1021

Development of High Performance Hybrid Rocket Fuels

Christopher Zaseck

Improving rocket safety and performance is essential for affordable, reliable, and frequent space travel. Hybrid rockets are a safe, relatively simple, and high performing alternative to traditional solid and liquid rockets that can help facilitate economical in-space propulsion. Hybrid rockets combust solid fuels such as rubber under a liquid oxidizer flow. In practice, the combustion occurs in a thick diffusion flame that is unable to burn the fuel quickly or completely. As a result, hybrid rocket fuels regress slowly and do not produce the mass flow and thrust necessary for most mission profiles. Generally, fuel regression rates must be improved by an order of magnitude, over baseline rubber, for feasible hybrid rocket use. This research seeks to improve the regression rate and performance of fast burning paraffin wax fuel through addition of metal and energetic additives. Initial screening experiments examined 1.2 cm diameter pellet combustion and regression under gaseous oxygen flow. Further optical combustion analysis at relevant chamber conditions yielded preliminary regression rate data. Finally, hybrid rocket experiments gave the final metrics of regression rate and performance. Initial results are promising and show that paraffin augmented with mechanically activated metals such as Titanium Carbon regresses ~7 times faster than rubber.

Coupled Orbit-Attitude Dynamics in the Three-Body Problem: A Family of Orbit-Attitude Periodic Solutions

Davide Guzzetti

Many relatively new techniques are being developed to incorporate the Circular Restricted Three-Body Problem (CR3BP) model into the early stages of the trajectory design. However, the attitude mission profile mostly remains reliant on methods established for a Keplerian dynamics. A coupled orbit-attitude model might leverage the CR3BP dynamics to explore alternative, possibly more effective, missions also in terms of the attitude response. The goal of this analysis is a nontrivial solution that is periodic both in its orbital and attitude states, when observed from the rotating frame. In the current investigation, tools largely used for the orbital analysis are effectively applied also in the coupled orbit-attitude problem. Organized and predictable motion appears to naturally exist – under certain conditions – also in such a model. As an example, a new family of orbit-attitude periodic solutions is discussed.

PURDUE
UNIVERSITY