# DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING
# WILLIAM MAXWELL REED SEMINAR SERIES

## "A passive guidance system for the sample return mission from International Space Station."


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**Abstract:**

In the post-Space Shuttle era, the frequent and economic return of science samples and space-manufactured items from the International Space Station (ISS) will innovate the space industry. For this, NASA has been developing a Small Payload Quick Return (SPQR) system, of which the concept of operation consists of three phases (orbital decay, reentry, and final landing) such that small payloads can be delivered to a safe and accurate location on the ground. Current studies on the payload return systems have mainly focused on developing guidance laws only for the orbital decay and parafoil phases and developing thermal protection for the reentry phase. This seminar proposes onboard guidance and vehicle design approaches for the reentry phase that can improve the landing accuracy of the SPQR mission. The trajectory analysis indicates that the concurrent optimization of the Reentry Interface (RI) and Ballistic Coefficient (BC) of the reentry vehicle can improve the final landing accuracy. Therefore, the onboard guidance that includes an air density estimation algorithm based on Inertial Measurement Unit (IMU) and Global Positioning System (GPS) measurement is proposed here. As the optimal BC is coupled with the RI, the reentry vehicle's BC should be configurable to interact with a dispersed RI, so an angle-adjustable tail design is adopted and implemented.


**Speaker Bio:**

Dr. Dae Young Lee received B.S. and M.S. degrees in mechanical engineering from Pusan National University, Pusan, South Korea. In 2016, he acquired M.S. and Ph.D. degrees in aerospace engineering from the University of Michigan, Ann Arbor, MI, USA. Before his Ph.D., he worked as a Research Engineer at Hyundai Heavy Industry and LS Industrial Systems from 2000 to 2009. He was also a Postdoctoral Researcher at the Center of Space Research of the University of Texas at Austin, TX, USA, from 2016 to 2018, then currently working as an Assistant Professor of aerospace engineering at Iowa State University, Ames, IA, USA. He is also the Director of Cardinal Space Laboratory and researching space missions based on a CubeSat platform, attitude determination and control (ADCS), and entry, descent, and landing (EDL) of a spacecraft. His research interests include nonlinear model predictive control of the car, drone, and spacecraft feet with various constraints and extended tracking of 3D targets using their point clouds.

**Date: Friday, January 13, 2023**
**Time: 3:00 PM EST**
**Place: Whitehall Classroom Building 110**
**Contact: Dr. Jesse Hoagg**

Attendance open to all interested persons

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