

The AAE Fall 2018 Colloquium Series

Presents

"Reincarnation of Apollo Lunar Descent Guidance: Landing Humans on Mars and Beyond"

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Thursday, September 6, 2018

ARMS 1109

3:00pm

Abstract

On the eve of the 50th anniversary of Apollo 11 lunar landing, spacefaring nations find themselves contemplating going back to the Moon, and eventually landing human on Mars and beyond. In aerospace guidance and control, particularly for space flight, a great premium is placed on technologies that have been flown before. The venerable Apollo powered descent guidance (APDG) approach is such a technology that landed the Lunar Module on the Moon for all successful Apollo lunar landing missions. Still, the limitations of APDG have become increasingly apparent and restraining as more diverse applications are considered, particularly for a human Mars mission. In this talk we will discuss how to "modernize" the 50-year old technology of Apollo powered descent guidance with the latest research advances. A methodology framework dubbed Augmented Apollo Powered Descent Guidance (A²PDG) will be presented. At the front end of A²PDG, the guidance command is generated by a member of a tunable powered descent guidance law family that include the existing APDG laws as special cases and preserve the reliability and predictability of APDG. Behind the scene, the guidance system is supported by a novel online powered descent initiation logic based on an advanced propellant-optimal rocket descent algorithm. The net product is a planetary powered descent guidance design that enjoys the reliability of a flight-proven legacy technology yet possesses the sophistication of the latest research. Compelling evidence is provided to demonstrate A²PDG by end-to-end closed-loop simulations for a human Mars mission.

Bio

Ping Lu received his B.S. degree from then Beijing Institute of Aeronautics, and Ph.D. degree in Aerospace Engineering from the University of Michigan. He was on the faculty of Aerospace Engineering at Iowa State University from 1990 to 2016 where his last position was Professor. He joined San Diego State University in 2016 to be a Professor and the Chair of the Aerospace Engineering Department. His research interests and expertise are in aerospace guidance, control, and autonomous trajectory planning and optimization. Prof. Lu was the recipient of the prestigious AIAA Mechanics and Control of Flight Award in 2008, "for contributions in advanced guidance algorithms for entry and ascent flight", and a recipient of the NASA Johnson Space Center Director's Innovation Group Achievement Award in 2016. Professor Lu is an AIAA Fellow, and the Editor-in-Chief of the AIAA Journal of Guidance, Control, and Dynamics.