Planetary Entry, Descent and Landing

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Abstract

Many planetary exploration missions rely on aeroassist technology to properly decelerate through a planetary atmosphere to a prescribed set of end conditions. Recent examples include the Galileo entry probe, the Mars Odyssey orbiter and the Phoenix Mars Scout lander. Design of aeroassist systems requires a synthesis of interplanetary navigation, atmospheric uncertainty, aerodynamics, heating, terminal descent and landing issues. This highly interactive course will address the state-of-the-art and future trends in aeroassist technology and is designed for program managers and non-specialists interested in gaining a working knowledge of planetary atmospheric flight. The course will broadly cover all aspects of aeroassist technology, with a focus on planetary entry, descent and landing. Material is based on that available in the public domain and comprises the basic theory of a semester-long graduate-level class in Planetary Entry, Descent and Landing, offered at the Georgia Institute of Technology. The course topics can be tailored for either a 2-day or 3-day presentation.

Short Course Outline

1) Introduction, 0.5 hours
2) Aeroassist mission classes and definitions, 4 hours
3) Approach navigation, 0.5 hours
4) Hypersonic aerodynamics, 1.5 hours
5) Ballistic entry flight mechanics, 2 hours
6) Lifting entry flight mechanics, 1 hour
7) GN&C, 0.5 hours
8) Verification and validation, 0.5 hours
9) Importance of simulation, 1 hour
10) Aerothermodynamics, 1.5 hours
11) Thermal protection systems, 1 hour
12) Aerodynamic decelerators, 2 hours
13) Terminal descent propulsion, 1 hour
14) Landing systems, 1 hour
15) Application - Mars Lander Comparison, 1 hour
16) Application - High Mass Mars Entry Systems, 1 hour
17) Summary, 0.5 hours
    Sample Problems
    References

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Dr. Braun has over twenty years experience performing design and analysis of planetary flight systems as a member of the technical staff of the NASA Langley Research Center and the Georgia Institute of Technology. His work has focused on systems aspects of Mars exploration, where he has contributed to the design, development, test, and operation of several robotic space flight systems. He was a member of the Mars Pathfinder design team from 1992 to 1997 and participated in landing operations for this mission. He has also contributed to the Mars Sample Return and Mars Surveyor 2001 flight projects. From June 2001 to August 2003, Dr. Braun served as the Mission Architect and Langley Proposal Manager for the Aerial Regional-scale Environmental Survey (ARES) Mars Scout mission, a proposed 2008 scientific survey utilizing a Mars airplane. In this capacity, he was responsible for integrating science, implementation risk and cost constraints into a balanced mission architecture and managing ARES Mars airplane development, including the successful ground-based and high-altitude flight test program. Dr. Braun received a B.S. in Aerospace Engineering from Penn State in 1987, a M.S. in Astronautics from the George Washington University in 1989, and a Ph.D. in Aeronautics and Astronautics from Stanford University in 1996. He has received the 1999 AIAA Lawrence Sperry Award, 2 NASA Exceptional Achievement Medals and 7 NASA Group Achievement Awards. He is a Fellow of the AIAA and the principle author or co-author of over 150 technical publications in the fields of atmospheric flight dynamics, planetary exploration, multidisciplinary design optimization, and systems engineering. Dr. Braun was selected as an AIAA Distinguished Lecturer in 2003.

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This shortcourse is offered through the Distance Learning and Professional Education office of the Georgia Institute of Technology. Budget questions should be directed to:

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