Advanced Computational Center for Entry System Simulation (ACCESS)

Vision Statement

- Revolutionize analysis and design of planetary entry systems through development of a fully integrated, interdisciplinary, simulation capability employing high fidelity, validated physics models, including uncertainty quantification (UQ) and reliability, that is enabled by high performance computing

Primary Research Objectives

- Integrated entry system analysis framework
- High fidelity models for flow physics, material and structural response incorporating UQ
- UQ & reliability for complex entry systems
- Execution on peta/exa-scale architectures

Institute Leadership Team

- Iain Boyd, U. Colorado, Director
- Marco Panesi, U. Illinois, Kinetics & Flow Physics Lead
- Graham Candler, U. Minnesota, Integration Lead
- Alexandre Martin, U. Kentucky, TPS Lead
- Alireza Doostan, U. Colorado, UQ & Reliability Lead

Institute Participants

Minnesota: B. Cockburn, J. Nichols, T. Schwartzentruber
Colorado: R. Macdonald, D. Marshall, T. Minton
Illinois: H. Johnson, F. Panerai, K. Stephani
Kentucky: M. Beck, C. Brehm, H. Chen, J. Maddox, S. Poovathingal
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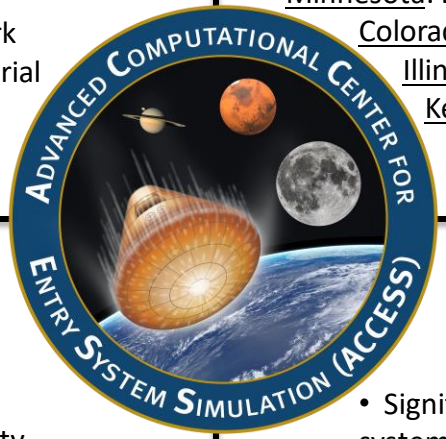

Approach

- Four tightly coupled Tasks
  1. Kinetic Rate & Physical Processes
  2. Integrated Simulation Framework
  3. TPS Features, Damage, and Failure
  4. Uncertainty Quantification & Reliability
- Develop models of all key processes, quantify their uncertainty, and incorporate into a simulation framework that effectively utilizes high performance computing
- Exercise capability on three NASA missions
  1. Dragonfly – Titan entry, 7 km/s, N_2+CH_4
  2. Mars Human Lander – Mars Entry, 5 km/s, CO_2+N_2
  3. Earth Entry Vehicle – Earth entry, 13 km/s, air

Benefits

- High fidelity models of all physical phenomena anchored by experiments and with quantified uncertainty
- Significant reduction of risk margins for entry system design via integrated UQ and Reliability
- Streamlining of entry system analysis using a single, comprehensive simulation framework
- Acceleration of entry system design through effective use of high performance computing platforms
- Ability to explore off-nominal and extreme entry system conditions, e.g., ballistic entry into Earth from Mars
- Educate the next generation of entry system engineers