



Generation of Aerothermal Databases for the Orion Multi-Purpose Crew Vehicle using Computational Fluid Dynamics

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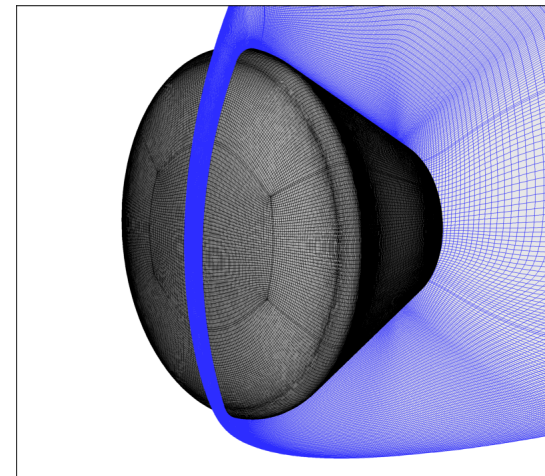
UC Davis NASA Orion Day
April 29, 2015



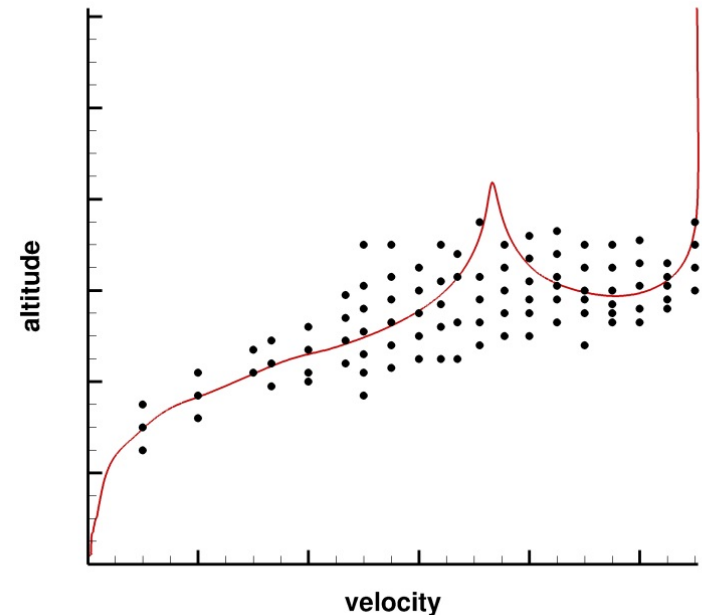
What is Computational Fluid Dynamics?



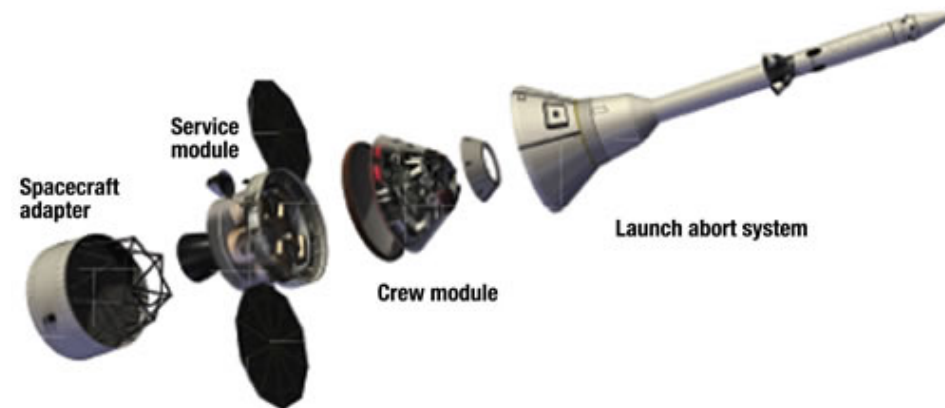
- **Computational Fluid Dynamics (CFD) uses numerical methods to analyze problems involving fluid flow and heat transfer**
- **Supercomputers are used to simulate the interaction of fluid flowing over an object**
- **Simulation solves the conservation laws (mass, momentum, and energy) on a discretized domain**
- **Numerical solutions complement ground-based and flight tests**



- During re-entry, the heating on the Orion MPCV depends on: vehicle geometry, vehicle orientation, entry conditions, ...
- Hundreds of *DPLR* simulations are computed to estimate the aerothermal environment for a wide range of flight conditions
- These high fidelity solutions are used by the *CBAERO* code to create aerothermal databases
- Databases are used to select the type of Thermal Protection System (TPS) material and thickness of TPS

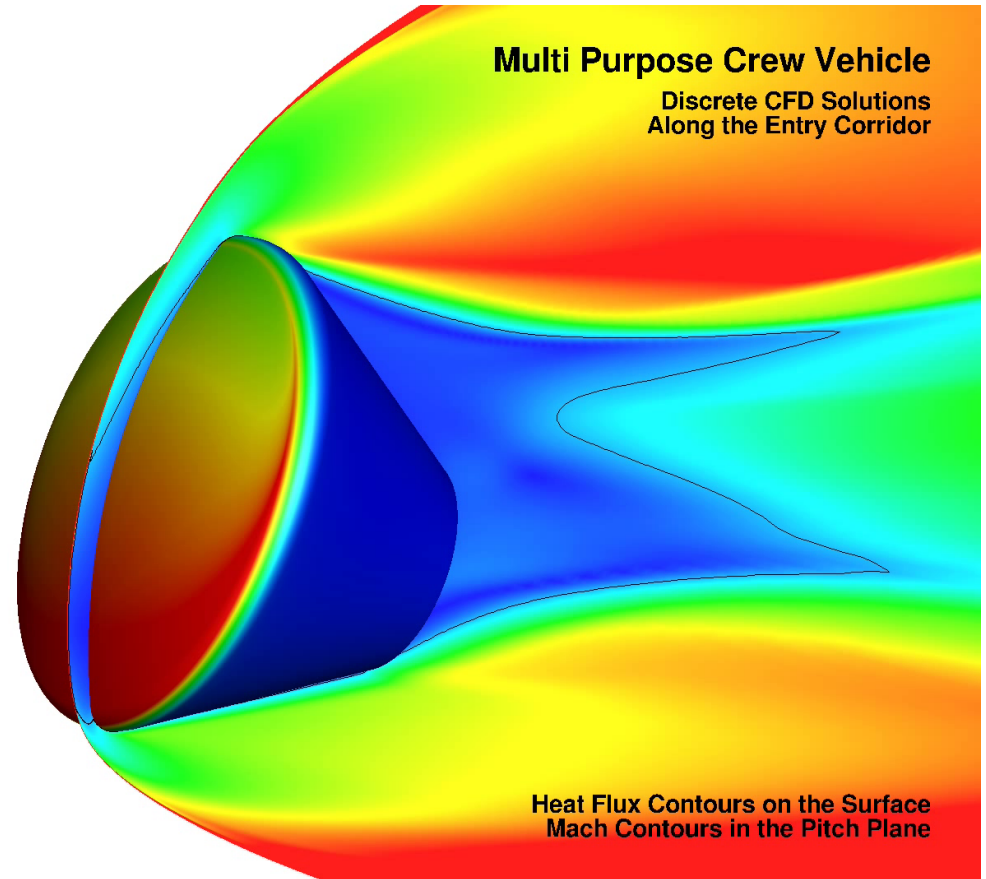
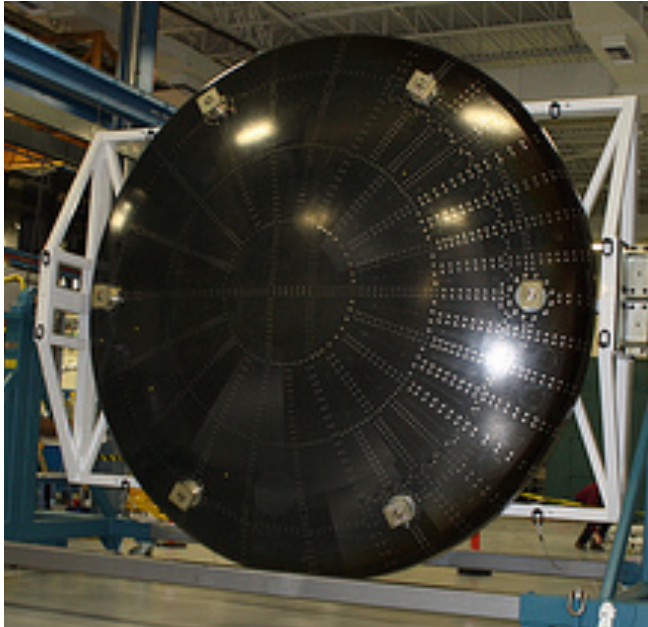


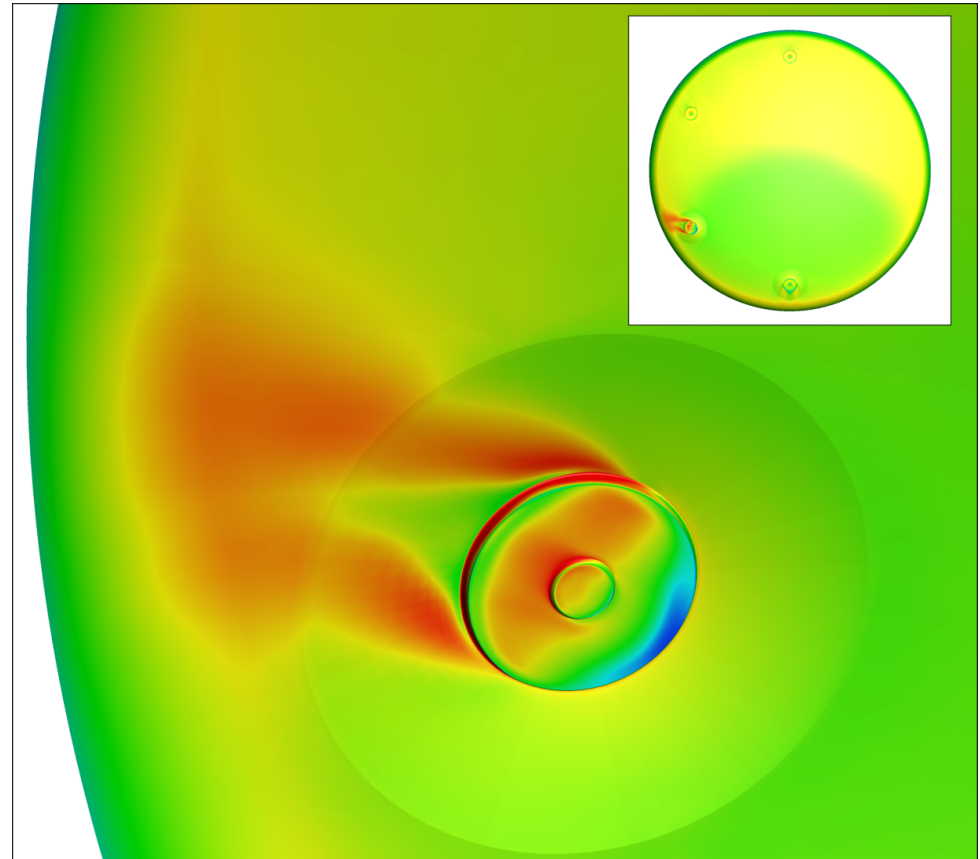
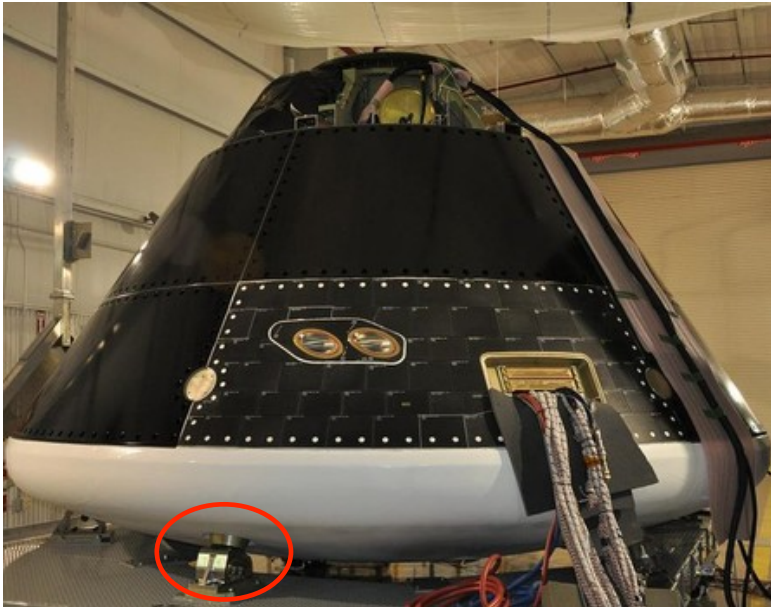
Sample trajectory and database cases





Orion Capsule Simulations

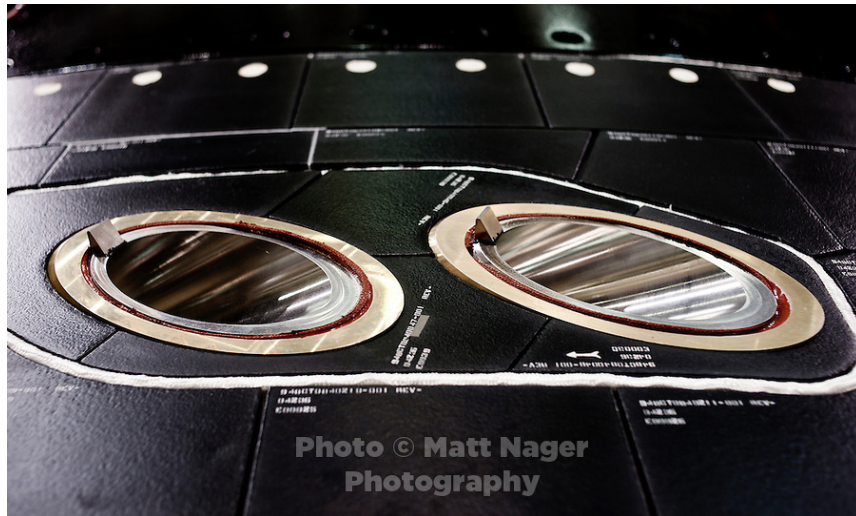
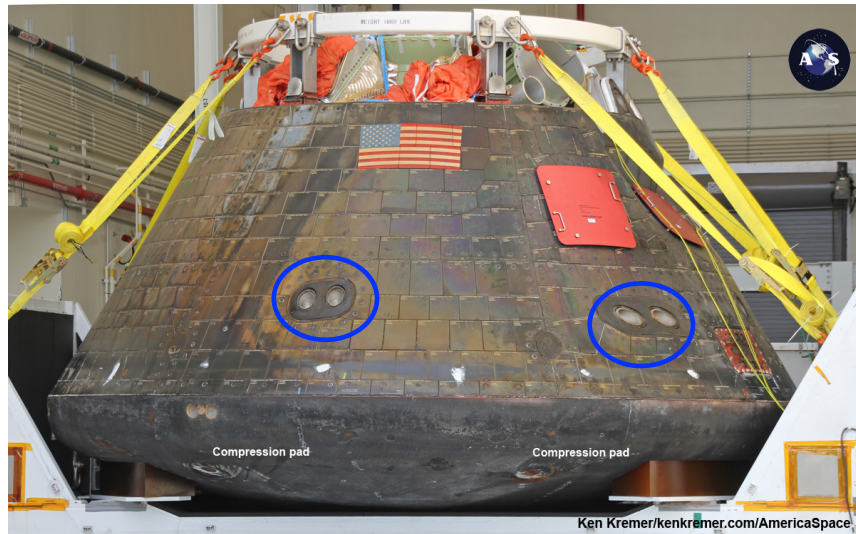




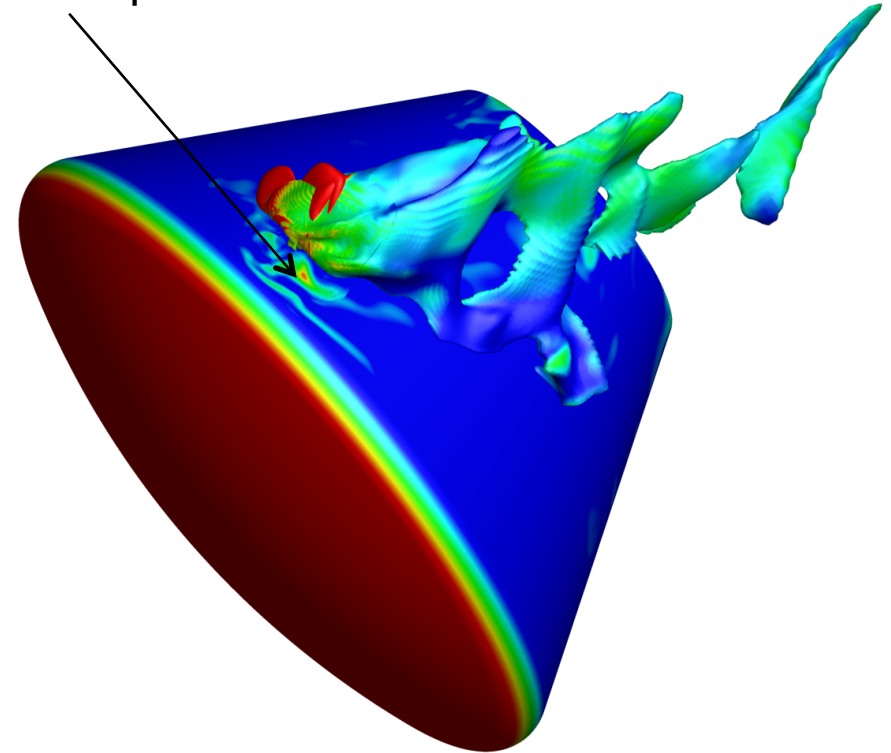
DPLR simulation showing the temperature contours near a compression pad



Reaction Control System (RCS) Jet Interactions



Hot spot on backshell



DPLR simulation showing temperature contours
on the Orion capsule and RCS plumes



Questions?