Information Sciences

Base Flow Model Validation

Marshall Space Flight Center, Alabama

A method was developed of obtaining propulsive base flow data in both hot and cold jet environments, at Mach numbers and altitude of relevance to NASA launcher designs. The base flow data was used to perform computational fluid dynamics (CFD) turbulence model assessments of base flow predictive capabilities in order to provide increased confidence in base thermal and pressure load predictions obtained from computational modeling efforts. Predictive CFD analyses were used in the design of the experiments, available propulsive models were used to reduce program costs and increase success, and a wind tunnel facility was used.

The data obtained allowed assessment of CFD/turbulence models in a complex flow environment, working within a building-block procedure to validation, where cold, non-reacting test data was first used for validation, followed by more complex reacting base flow validation.

This work was done by Neeraj Sinha and Kevin Brinckman of Combustion Research and Flow Technology, and Bernard Jansen and John Seiner of the University of Mississippi for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32779-1.

Minimum Landing Error Powered-Descent Guidance for Planetary Missions

NASA's Jet Propulsion Laboratory, Pasadena, California

An algorithm improves the accuracy with which a lander can be delivered to the surface of Mars. The main idea behind this innovation is the use of a "lossless convexification," which converts an otherwise non-convex constraint related to thruster throttling to a convex constraint, enabling convex optimization to be used. The convexification leads directly to an algorithm that guarantees finding the global optimum of the original nonconvex optimization problem with a deterministic upper bound on the number of iterations required for convergence.

In this innovation, previous work in powered-descent guidance using convex optimization is extended to handle the case where the lander must get as close as possible to the target given the available fuel, but is not required to arrive exactly at the target. The new algorithm calculates the minimum-fuel trajectory to the target, if one exists, and calculates the trajectory that minimizes the distance to the target if no solution to the target exists. This approach poses the problem as two Second-Order Cone Programs, which can be solved to global optimality with deterministic bounds on the number of iterations required.

This work was done by Lars Blackmore and Behcet Acikmese of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to NPO-46647, volume and number of this NASA Tech Briefs *issue, and the page number.*

Framework for Integrating Science Data Processing Algorithms Into Process Control Systems

This technique can be used for data processing and management systems.

NASA's Jet Propulsion Laboratory, Pasadena, California

A software framework called PCS Task Wrapper is responsible for standardizing the setup, process initiation, execution, and file management tasks surrounding the execution of science data algorithms, which are referred to by NASA as Product Generation Executives (PGEs). PGEs codify a scientific algorithm, some step in the overall scientific process involved in a mission science workflow.

The PCS Task Wrapper provides a stable operating environment to the underlying PGE during its execution lifecycle. If the PGE requires a file, or metadata regarding the file, the PCS Task Wrapper is responsible for delivering that information to the PGE in a manner that meets its requirements. If the PGE requires knowledge of upstream or downstream PGEs in a sequence of executions, that information is also made available. Finally, if information regarding disk space, or node