JOURNAL OF SPACECRAFT AND ROCKETS
Vol. 38, No. 5, September–October 2001

Overview of Special Section on X-33 Aerothermodynamics

EXTENSIVE aerothermodynamic studies were performed by NASA in support of the X-33 program using both experimental and computational methods to develop the aerothermodynamic database for design, construction, and flight of the X-33 vehicle. This information was used for configuration screening and outer-mold-line refinements, to enhance aerodynamic performance, define the aeroheating environment, and optimize the trajectory. This issue of the *Journal of Spacecraft and Rockets* contains five papers that collectively represent a significant portion of the NASA Langley Research Center's contribution to this aerothermodynamic database. In this special section of the *Journal*, comprehensive experimental measurements and computational predictions of hypersonic aerodynamic coefficients, global aeroheating characteristics, and boundary-layer transition are presented for a wide range of simulation parameters, including Mach number, Reynolds number, shock-layer specific heat ratio (which simulates real-gas effects), vehicle configuration, control surface deflections, and angles of attack.

The X-33 program grew out of a NASA decision in the mid-1990s to partner with industry to develop technologies for a commercially operated, fully reusable launch vehicle (RLV) that would substantially improve affordability, reliability, and safety over the current space shuttle. With the intent of reducing life-cycle and operations costs, the focus was on single-stage-to-orbit (SSTO) concepts with the expectation that a commercial airline mode of operation eventually would evolve. Three major airframe manufacturers, Rockwell International, Lockheed Martin, and McDonnell Douglas, were selected by NASA in 1995 to compete their proposed SSTO-RLV concepts in the first phase of an advanced technology demonstrator program. Approximately one year later, the Lockheed Martin Skunk Works lifting body concept was selected for the second phase; that is, for design, construction, and suborbital, autonomous flight testing of a half-scale SSTO-RLV referred to as the X-33. The goal of the X-33 program was to rapidly advance the technology readiness level of numerous, critical technologies within the major technical disciplines required for the design of all aerospace vehicles, such as aerothermodynamics, structures, materials, and propulsion, etc.

At the time the research presented herein was being performed, the expectation was that the methodologies and experimental and computational tools applied in these studies would be calibrated and/or validated by flight data; i.e., by the comparison of preflight predictions to flight measurements of aerodynamic coefficients and discrete surface pressures and temperatures. However, at the time of this writing, NASA made the decision to allow the X-33 contract to expire effective at the end of March 2001. The termination of the X-33 program does not take away from the outstanding efforts to develop the aerothermodynamic information essential for the flight of the X-33. The technical lessons learned during the X-33 program and the experimental and computational tools developed and refined for that program are being applied to current programs such as the X-37 Advanced Technology Vehicle, X-38/Crew Return Vehicle, and X-43 Hypersonic Airbreathing Propulsion demonstrator and will serve to mitigate the risk associated with the design and flight of these and future aerospace vehicles.

Charles G. Miller
NASA Langley Research Center