Journal of Guidance, Control, and Dynamics
Vol. 27, No. 6, November–December 2004

Introduction: Reusable Launch Vehicle Guidance and Control

TOWARD the end of the 1990s, both NASA and the U.S. Air Force directed significant resources and funding toward the development of space-access vehicle technologies that would reduce launch costs and turnaround times in comparison with the Shuttle. Vehicles such as the X-33, X-34, X-37, and X-40A were all being developed to test the new technologies that were intended to make space-access vehicle operations more closely resemble those of aircraft. Most vehicle concepts, grouped under the class of second-generation reusable launch vehicles (RLVs), were to be autonomous, in that they were to be capable of flying missions with little or no input from the ground and without aid from a pilot or astronaut. From a guidance and control perspective, the autonomy, safety, responsiveness, and turnaround time goals set for the next generation of RLVs created challenges in trajectory optimization and fault-tolerant guidance and control systems. This special section of the *Journal of Guidance, Control, and Dynamics* collects papers that provide a glimpse of some of the advanced concepts for trajectory optimization, guidance, and control that may contribute to the achievement of these objectives. All of the papers address one or more of the challenges that must be overcome to meet the proposed objectives for the next generation of RLVs.

The special section starts with a paper by Calise and Brant, who present a method for ascent trajectory generation that may reduce the time required for preflight abort planning and allow for possible recovery in the case of unplanned emergencies by rapidly generating abort trajectories when vehicle failures occur. Drake, Xin, and Balakrishnan present a control methodology that has been tested in a high fidelity simulation and has performed well, for the ascent flight phase, without the need for extensive gain schedule tables. Shen and Lu advance an entry guidance approach that is capable of generating lateral guidance commands to ensure correct directional control of the entry trajectory for a wide range of missions and dispersions, without the need for manual tuning. Hanson and Jones present the results of a study that subjected a number of advanced entry-guidance methods to a battery of tests in a high-fidelity simulation environment to evaluate the strengths and weaknesses of each approach. Next, Kluever presents a new method for rapidly generating approach and landing trajectories in the presence of wind, energy, and drag dispersions. Finally, Schierman et al. present a fault-tolerant autonomous landing system for an entry vehicle that was flight demonstrated using an in-flight simulator.

I express my appreciation to the authors and review team for their help in composing this special section, as well as to Associate Editor Ping Lu for handling the peer review of the last paper in the section. As a final note, although significant progress has been made over the past few years by guidance and control researchers toward meeting the demands of the next generation of RLVs, the implementation of many new approaches will require advances in flight software verification and validation before their full potential can be realized. Notwithstanding this requirement, the novel approaches to meeting next-generation RLV guidance and control challenges testify to the resourcefulness and creativity of the community.

David B. Doman
Associate Editor