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Benchmark Active Control Technology: Part I

THE Benchmark Active Control Technology (BACT) research project was conducted at NASA Langley Research Center, in collaboration with related research from Duke University, Texas A&M, University of Minnesota, Vanderbilt University, University of Florida, University of Nevada, The Boeing Company (St. Louis), The Boeing Company (Long Beach), and Honeywell. The BACT project tested a standard instrumented wing model with the NACA 0012 airfoil section that was mounted on a pitch and plunge apparatus in the Langley Transonic Dynamics Tunnel, with the objectives to 1) measure and archive unsteady aerodynamics data in the transonic flow regime and 2) study, record, and actively control various critical transonic flutter instability phenomena. This vast collection of benchmark data was used for verification and validation of computational fluid dynamics analyses techniques and robust flutter-suppression control law synthesis methodologies. For flutter suppression control laws, a wide variety of design techniques (e.g., classical, minimax, H-infinity, robust passification, structured singular value, μ-synthesis, and neural network) was used. A set of control laws was implemented digitally and tested for active flutter suppression in the wind tunnel. Eighteen papers that describe this collaborative research are presented in this special section (six in this issue and the remainder in the next two issues of the *Journal of Guidance, Control, and Dynamics*). We hope that these papers will be of enduring interest to both the fluid mechanics and control communities.

This issue contains the first set of six papers. The first paper, by Scott, Hoadley, Wieseman, and Durham, describes in detail the objectives of the project, along with a summary of interesting unsteady aerodynamic data and flutter instability phenomena encountered during the test. The paper by Bennett, Scott, and Wieseman provides details of unsteady aerodynamic data collected and archived for an AGARD compendium on unsteady aerodynamics test cases. The following three papers describe flutter suppression control law design techniques and test results. The paper by Mukhopadhyay presents robust flutter-suppression control law design processes, using classical and minimax methods. The simple classical control law was implemented and successfully tested for suppressing flutter in the wind-tunnel. The next paper, by Kelkar and Joshi, presents four robust passification techniques. Barker and Balas present the design of two linear paramenter-varying gain scheduled controllers through a natural extension of H-infinity control. The last paper in this section, by Frampton and Clark, presents experiments on control of limit cycle oscillation.

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