

Aerospace America
2017 Year in Review
Modeling and Simulation
Drafted by Jeffery Schroeder
September 27, 2017

Modeling and simulation's contribution to solving aerospace problems continues to grow as expected. This article discusses several major simulation studies, a review of problems that need additional effort, and trends for the future.

The commercial transport airplane community will soon comply with a 2019 requirement to train all of their pilots on upset prevention and recovery. In the U.S., this requires training airline pilots to prevent full aerodynamic stalls, or if not prevented, to recover from such a stall. All of this training will be performed in simulation. Aircraft manufacturers and engineering consulting firms are developing improved aerodynamic models to enable the stall and upset training, and as of September, 2017, approximately 40 flight simulators have been upgraded and approved by the FAA.

The University of Toronto, with Bombardier as a subcontractor, completed a transfer of training simulation study on a Q400 aircraft model that examined how upgraded stall aerodynamics developed with engineering methods, rather than on flight test data, might affect or influence stall training. Figure 1 [forthcoming] is a photo of the cockpit used for the study.

Several high-fidelity simulators are the tool for examining possible simplified criteria for commercial transport go-arounds. While criteria presently exist for stabilized approaches, a recent study showed that approximately only 3% of time that these criteria are exceeded do crews conduct a go around. Fewer, but key, criteria are being examined with the decision altitude being lowered to hopefully reflect actual decision making by today's crews.

A final study on objective flight simulator motion cueing criteria was completed on the NASA Ames Vertical Motion Simulator. New simulators in the U.S. must now objectively measure their motion responses using the Objective Motion Cueing Test that was first documented by the International Civil Aviation Organization. To date, while solid measurement techniques are being used, consensus criteria to assess the measurements are lacking. Results from this final study will propose criteria.

In June 2017, flight simulation experts gathered at the Royal Aeronautical Society and developed seven flight simulator problems that need further attention. These include (1) better aligning simulator qualification procedures with training objectives; (2) reducing flight test hours significantly via simulation; (3) creating consensus objective motion standards; (4) developing a cost-effective and widely accessible rotorcraft simulator; (5) finding good objective measures for training effectiveness; (6) seamless sharing of scenarios across simulator environments; and (7) making simulated turbulence feel more like real aircraft turbulence.

An industry trend is that model-based development, and model-based system engineering, are slowly gaining acceptance as a way to reduce aerospace product development costs by enabling early requirements validation and systems integration, long before any real hardware is built.

While some assume that flight simulator is a mature discipline, a few significant advances are coming closer to reality. One is simulated air traffic control. Typically, a simulator instructor serves as a bare bones air traffic controller during training, which serves some limited purposes, but it is far from an immersive experience. Simulated air traffic control may improve that immersion, and it can also mimic scenarios where miscommunication, over-aggressiveness, or blunders between air traffic and the cockpit have adversely affected safety.

Another advance may be the possible use of virtual reality goggles to enable lower cost flight simulator training, especially for the general aviation market.

The Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) Project at NASA is developing an air traffic management simulation capability to explore the integration of alternative concepts, technologies and architectures in the NAS. This real-time “shadow-mode” NAS will examine the robustness, stability and reliability of new approaches and technologies that could enhance the entire NAS or parts thereof. Simulations will take actual operational input from the NAS – such factors as weather conditions, flight plans, airports’ arrival rates and system constraints – to ensure safe and seamless operations. The capability will reduce the time to test concepts, technologies, and their interactions, interoperability and integration. It will be capable of real/live, virtual, constructive and hybrid-mode operations to simultaneously operate in real and virtual traffic.

NASA is also developing an integrated Live Virtual Constructive (LVC) Distributed Test Environment test to develop, test, and explore key challenges and technologies for integrating UAS operations in the NAS. The goal is to develop a relevant test environment for use in generating research findings to develop and validate human systems integration (HSI) Guidelines, sense and avoid (SAA), and command and control (C2) minimum operational performance standards with test scenarios supporting integration of UAS into the NAS. The basic framework of the LVC is operational and has been tested and validated in a series of operational evaluations.