

## **LESSONS LEARNED FROM MODELING & SIMULATION USE IN THE FLIGHT DYNAMICS TEST AND EVALUATION PROCESS 55 YEARS OF AFFTC EXPERIENCE**

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### **ABSTRACT**

The United States Air Force Flight Test Center (AFFTC) has a long history of using modeling and simulation (M&S) in the test and evaluation (T&E) process. The first documented use of what could be considered modern M&S was in 1954 on the X-2 flight test program. The then new 'analog' simulation was used to define the nonlinear inertial coupling characteristics, which had earlier led to the loss of the X-2 aircraft. Since this first use, M&S has been a standard tool at the AFFTC for the flight test of developmental and research aircraft. During the intervening 55 years, the AFFTC has learned valuable lessons in the application of M&S to the T&E process.

While most of the lessons learned to date have been from use in the aircraft performance and flying qualities technical arenas, the lessons are general and applicable to many other uses of M&S in the T&E process. Advancing technology and complex systems integration requirements are resulting in increased M&S use across a broader spectrum of technical disciplines. As M&S use broadens, applying past lessons will facilitate the integration of M&S into the overall T&E process.

The specific lessons learned are in three basic categories: understanding the simulation and its limitations, model fidelity and updating, and the multiple uses of M&S across the T&E process. By definition, all simulations are approximations of reality and understanding these limitations will ensure that results are used appropriately. All simulations are also bound by the fidelity of the models used. Understanding the implications of model fidelity and the need for model updating from test results is a key factor in using M&S in the T&E process.

Finally, the use of M&S across the T&E process is only limited by the ingenuity of the user. Modeling and simulation should be used to benefit multiple segments across the technical spectrum.