Air Force SBIR Transition Impact

Advanced Simulation Tools Enable Aerial Refueling of UAVs and UCAVs

- **Advanced simulation and modeling supports development of UAVs and UCAVs capabilities.**
- **Test techniques and software developed to measure aircraft aero-dynamic characteristics while in close formation.**
- **This technology is being used to enable aerial refueling of the UCAV (X-45) under the AAR (Autonomous Aerial Refueling) program. Wind tunnel testing has been conducted on a generic UAV behind a KC-135R (simulating USAF refueling) and behind an F-18 (simulating Navy "buddy" refueling). Further tests are planned with the X-45 as the receiver aircraft.**

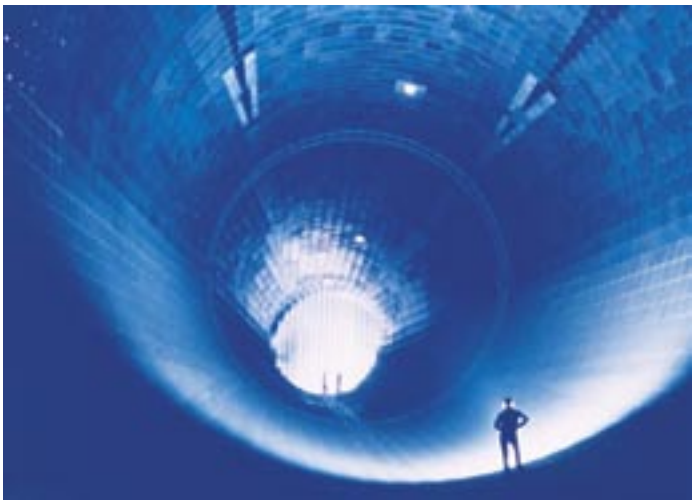
Air Force Requirements

As the Air Force's reliance on Unmanned Aerial Vehicle (UAV) and Unmanned Combat Aerial Vehicles (UCAV) increases, so do its simulation and modeling requirements. Operations of UAV and UCAV groups will require close formation flight to gain tactical advantage, attain performance benefits, and/or perform in flight refueling. Since human operators are to be located in remote air or ground stations, advanced flight control algorithms need to be developed. To facilitate the development of robust control laws and reduce project risk, the Air Force requires advanced simulation and modeling capabilities for air vehicles in close formation.

SBIR Technology

Bihrle Applied Research Inc. (BAR) won Phase I and Phase II SBIR contracts to improve the state of the art in developing simulations of air vehicles flying in close formation. In this effort, BAR is addressing Air Force needs in two areas, flight model development and simulation tools. The development of models for close formation flight has historically been based on computational aerodynamics. While this approach is good for preliminary estimates, it results in over-simplification of the characterizing of aerodynamic phenomena. This over-simplification often leads to the development of low-fidelity modeling. During its Phase II work, BAR developed test techniques, apparatus, and data acquisition software that can be used during wind tunnel tests to measure aircraft aerodynamic characteristics while in close formation. Data from wind tunnel tests utilizing this improved technology can be used to refine preliminary computational estimates and refine algorithms. It can also be implemented directly into simulation models.

The second issue BAR addressed during Phase II is the need for advanced simulation tools for close formation flight. Based on its D-Six PC-Based simulation environment (a product of an SBIR Phase I in 1995), BAR is developing a comprehensive simulation capability that allows users to load multiple independent simulations into a single application. This capability allows the Air Force to develop a single flight model and reuse it during a single simulation



session. Using two (or more) simulations loaded into the environment, an engineer may apply a global control algorithm to a simulated formation flight scenario. Until now, development sessions like these have required multiple simulations running on multiple computers or a single complex simulation structure. The advanced simulation capability being developed by BAR will greatly simplify the complex task of modeling multiple vehicles, while requiring less development time for engineers.

Air Force Transition Payoff

This technology is being used to enable aerial refueling of the UCAV (X-45) under the AAR (Autonomous Aerial Refueling) program. Wind tunnel testing has been conducted on a generic UAV behind a KC-135R (simulating USAF refueling) and behind an F-18 (simulating Navy "buddy" refueling). Further tests are planned with the X-45 as the receiver aircraft. Results from these tests will be incorporated into the new D-Six software package developed under this SBIR. UAV's that are capable of aerial refueling will be able to stay on station much longer or fly greater distances, increasing mission effectiveness and reducing forward basing requirements.

SBIR Topic:
#AF 98-175

Title:
Development of Multi-Vehicle Aerodynamics Simulation Models

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