



## Flight Model Services

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## Expertise

Since 1973, Bihrlle Applied Research Inc (BAR) has provided the military and civil aerospace industry with expertise in the area of flight dynamics modeling and analysis, compiling a resume of over 150 aircraft configurations. Leveraging a unique range of capabilities and resources, BAR has played a key role in all aspects of flight model development efforts, from the collection and analysis of source data, through the development of complex math-models, to the validation and final acceptance of advanced trainers.

## Flight Model Development

BAR is a provider of mathematical software models that are used for both engineering and training applications. BAR tailors each flight model development project to the specific requirements of the customer, taking into account fidelity specifications, available source data, simulation application, and budget. Given these requirements, BAR develops the flight model using the appropriate source data, including aircraft manufacturer data packages, wind tunnel test data, flight test data, or predictive data generated by BAR's aerodynamic prediction software tools. Whether the application is a full mission military trainer, a civil Level-D Full Flight Simulator (FFS), an engineering simulator or a predictive threat model for mission simulations, BAR will meet your flight model needs.

## Sub-System Model Development

To complement its flight model development capability, BAR excels at the development of sub-system models including engine, FADEC, landing gear models, electrical system models, and hydraulic system models. In addition to modeling normal operations, models can be further enhanced to include the system failure modes and malfunction logic required to meet specific training requirements.

## Flight Model Update

Like most components of a simulator, flight models must be updated to keep up with aircraft configuration changes, regulatory agency requirements and endorsements, and the latest advances in modeling techniques and model validation. BAR engineers have unique experience in the analysis of legacy flight models as well as the expertise to integrate model updates to improve fidelity in all areas of the flight envelope.

## Upset and Adverse Effects Modeling

Modern source data collection and analysis techniques developed by BAR have lead to significant advances in the state of the art in modeling vehicle response during upset, recovery and in-flight icing conditions. By incorporating the data needed for accurate predictions of icing, stall and post-stall behaviors, not only is the flight envelope of a simulator expanded, but pilot awareness is significantly enhanced during these dangerous conditions -- a training capability that has been proven to save lives as well as vehicles.

## Source Data Collection

Since the 1970's, BAR has been a leader in the measurement of aerodynamic forces and moments derived from wind tunnel and flight test. During this time, BAR has developed advanced test techniques for collecting large amplitude static and dynamic aerodynamic data, icing effects data, and aerodynamic data characterizing the effects of propeller slip stream, resulting in the highest fidelity models.

## Selected Examples

### P-8A Stall Modeling

The BAR StallBox simulator update solution provides the modeling for stall and post-stall aerodynamics and Upset Prevention and Recovery Training (UPRT) instructor displays for P-8A training devices worldwide. The P-8A stall model, hosted in the StallBox computer, interacts with the baseline training device to provide representative aircraft flight dynamics during full-stall recovery training, while enhanced displays provide improved situational awareness for UPRT instructors. The P-8A StallBox solution leverages technology and data resulting from a U.S. Navy Small-Business Innovative Research (SBIR) program.

### Chinook Full-Mission Flight Model

BAR has developed a comprehensive, full-envelope flight model of the Chinook helicopter to support full mission training including operation with slung loads. The flight model solution includes blade-element models of the twin rotor system, detailed engine and FADEC models, and modeling of the advanced automated flight control system. Aircraft subsystems, including hydraulic, electric, and fuel systems were also modeled.

### F-16 Full-Mission Flight Model

BAR has developed a full-envelope high-fidelity flight model of the F-16 that is currently training pilots in the U.S., Singapore, Chile and Thailand. This model incorporates state-of-the-art approaches in the modeling of aircraft aerodynamics to provide users with realistic aircraft response throughout the flight envelope. This capability enables recovery training from deep stall and spin.

### UAS Crew Training

In support of BNSF Railway's UAS initiatives, BAR developed a flight-representative quad-copter math model, including sub-system models and failure modes. This model was incorporated into a BAR-developed UAS crew training simulator with emulated pilot controller and head-mounted display.

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