

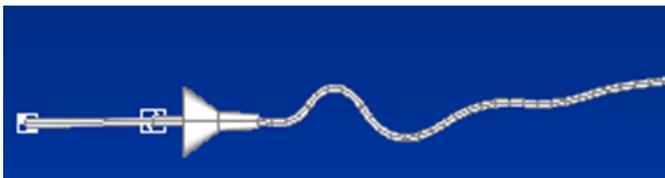
SDI Engineering has developed an aerial refueling modeling and simulation tool using multi-body dynamics methods in MATLAB and SimMechanics. This development continues under a contract sponsored by NAVAIR in order to better understand the dynamics of the hose and drogue, reeling mechanism, probe, and the resulting loads during aerial refueling operations. The software can be used in the detailed analysis of aerial refueling operations for new technologies, incident investigations, evaluations of flight control or maneuver strategies, and probe loads predictive analysis for design, flight testing and certification.

## Approach

- Lumped-parameter models of the hose, drogue and probe allow simulation of structural behavior including temperature dependent non-linear stiffness and damping
- Structural models can be modified to simulate refueling events using flying boom and boom-to-drogue adapters
- Hose aerodynamic model included to capture aeroelastic behavior during hose whip events
- Hydraulic reeling mechanism model allows regulation of hose tension during aerial refueling
- Probe-drogue engagement model allows simulation of all phases of aerial refueling

## Validation Efforts

- Hose structural model validated through tests of hose stiffness and damping characteristics
- Hose aerodynamic model validated through comparison to other commercial and academic aerodynamic models
- Probe structural model validated through FEA in Nastran and probe static and dynamic deflection tests
- Validation of complete aerial refueling simulation using flight test data is planned under current contract with NAVAIR



## Technologies and Tools

- Nonlinear multi-body dynamics simulation
- Aerial refueling subsystem modeling including hydraulics and electronics
- Based in MATLAB / Simulink / SimMechanics

## Anticipated Benefits

- Realistic hose whip simulation and prediction
- Accurate prediction of loads on refueling hose, hose reel, drogue, and probe during normal operation and failure cases
- Application to various tanker and receiver aircraft
- Loads analysis supports design, testing, and certification of aerial refueling systems
- Reduced-order model for real-time analysis and integration with U.S. Navy's CASTLE software for pilot-in-the-loop simulations
- Possible integration with other simulation tools allows more complex aerodynamic analysis including aircraft aeroelastics and tanker-receiver wake effects

