Gain the Competitive Edge in Virtual Aerospace Vehicle Prototyping

OVERVIEW
The Aerospace Vehicle library V1.1, in conjunction with MSC.EASY5™, gives you the ability to quickly build and analyze dynamic models of aircraft, missiles, and launch vehicles. Use this library to answer many of the tough questions you face in your design:
- Does the control system satisfy both transient and steady-state requirements?
- How much force must the actuators deliver to meet maneuverability requirements?
- How do gusts and turbulence affect ride quality?
- How do system nonlinearities change performance from the linear predictions?
- How do control system sampling rates and delays affect stability and performance?

These questions cannot be answered with linear approximations or simplified models; they require the support of high-order, nonlinear models of your vehicle. Yet these models must be available early in your design process so that they can be used to help set specifications, from propulsion to control systems to actuator power systems. All of this can be easily modeled with the Aerospace Vehicle library.

MSC.EASY5 has been one of the primary design tools for generations of Boeing aircraft, missiles, spacecraft, and launch vehicles. The Aerospace Vehicle library builds on this experience, offering you a new tool for developing aerospace vehicles. The components in this library are:
- Representative of the dynamics of all major aerospace vehicle subsystems.
- Sufficiently detailed to provide true dynamic response of aerospace vehicles in flight.
- Simple enough to be used in system-level models by not requiring unnecessarily detailed data or unreasonable amounts of computer time to execute.

CAPABILITIES
- Choice of linearized and nonlinear rigid body dynamics
- A baseline approach to computing aerodynamic forces and moments and the tools needed to implement other approaches
- Special-purpose table components to speed the lookup of aerodynamic derivatives
- Easy-to-use aerodynamic data management
- An Earth model with three choices of gravity computation
- An atmosphere model with built-in tables and the capability of accessing user-supplied tables
- Models of discrete gust and either Von Karman or Dryden turbulence
- Models of typical instruments and control mechanisms
- Complete rigid 6 DOF equations of motion
- Develop and test flight control algorithms

BENEFITS
- Gain confidence in your design with a reliable, industrial-strength modeling tool
- Quickly build and analyze your model without writing complex code
- Extend your model through other MSC.EASY5 libraries, custom components, custom code, and integration with controls software
- Easy customization with wind tunnel aerodynamic data
- Model generation compatible with other specialized MSC.EASY5 libraries, including hydraulics, gas dynamics, pneumatics and electric systems libraries
MODEL AEROSPACE VEHICLES WITHOUT WRITING CODE
Each Aerospace Vehicle library component contains the differential and algebraic equations that represent the dynamics of your vehicle. You do not need to be an expert in flight dynamics or computer modeling to use this library; you can build your model using MSC.EASY5’s drag-and-drop modeling capability.

Create your own components with MSC.EASY5’s advanced modeling tool, add them to your model, and store them in your own custom library. MSC.EASY5’s configuration control tracks all component changes and automatically updates any model affected by a change.

Add your own code directly to your model or make calls to FORTRAN, C, and ADA.

Test prototype control software by integrating your MSC.EASY5 model with controller models from Simulink® or MATRIXx®. You can even take your MSC.EASY5™ model into your real-time simulation laboratory.

CONDUCT HIGH PERFORMANCE SIMULATIONS
Your MSC.EASY5 model will support simulation of short- and long-term motion and simulation of violent disturbances to the vehicle’s motion, such as failure to zero thrust of an outboard engine. The following plot shows the decay in thrust and the control surface angles. The ailerons move to a steady value to balance the unbalanced engine roll torque. The rudder deflects in an attempt to cancel the sudden yaw rate, but the washout filter causes it to return to zero. The elevator deflection continues to build in an attempt to pitch the aircraft up and return to the commanded altitude. You can also analyze the data from your model, just as you would analyze data from a laboratory, by performing signal processing, system identification, and curve fitting.

PERFORM LINEAR ANALYSIS AND CONTROL SYSTEM DESIGN
Once you use a model for simulation, you can use it for both classical control analysis and modern control design.

Classical control analysis is simple using MSC.EASY5’s built-in tools. You can perform root locus, stability, and frequency response analysis with a click of the mouse.

Modern control design methods are hosted in the MSC.EASY5 Matrix Algebra Tool. You can perform LQR/LQG design, optimization, and pole placement. Your MSC.EASY5 model is seamlessly integrated with these and other tools in the Matrix Algebra Tool.

AEROSPACE VEHICLE LIBRARY COMPONENTS

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To find your local MSC.Software office or to learn more about our company and our products, please contact:

Corporate:
MSC.Software Corporation
2 MacArthur Place
Santa Ana, California 92707 USA
Tel: 1 714 540.8900
Fax: 1 714 784.4056

Customer Care Center:
1 800 642.7437 (U.S. only)
1 978 453.5310 (International)
customer.care@mscsoftware.com

Worldwide Web - www.mscsoftware.com
On-line Purchases - www.engineering-e.com

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This power spectral density plot shows the lateral acceleration computed from a 300-sec simulation of an aircraft subjected to 5-m/sec rms turbulence.

This plot shows the response to a discrete gust—a very short-term phenomenon.