



AIRCRAFT DYNAMICS LIBRARY

Overview



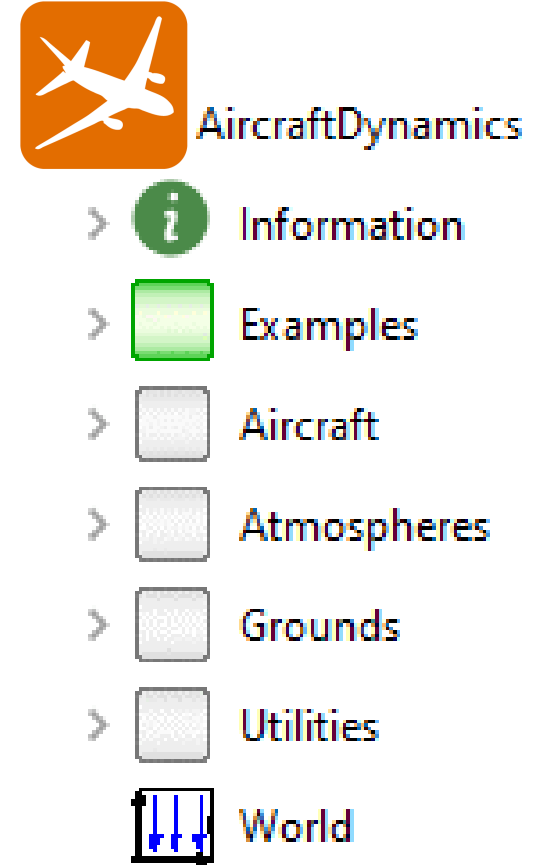
AGENDA

- About Aircraft Dynamics Library
- Key Features
- Key Capabilities
- Key Applications
- Library Contents
- Modelon Compatibility
- Latest Release



ABOUT AIRCRAFT DYNAMICS LIBRARY

- Modelica library for the design and analysis of aircraft and its sub-systems
- Design and verification of the entire aircraft package, coupling sizing and performance with detailed design of sub-systems
- Powerful aircraft level sizing and synthesis methods and six degrees of freedom models of aircraft dynamics
- Large set of pre-defined models and templates





KEY BENEFITS

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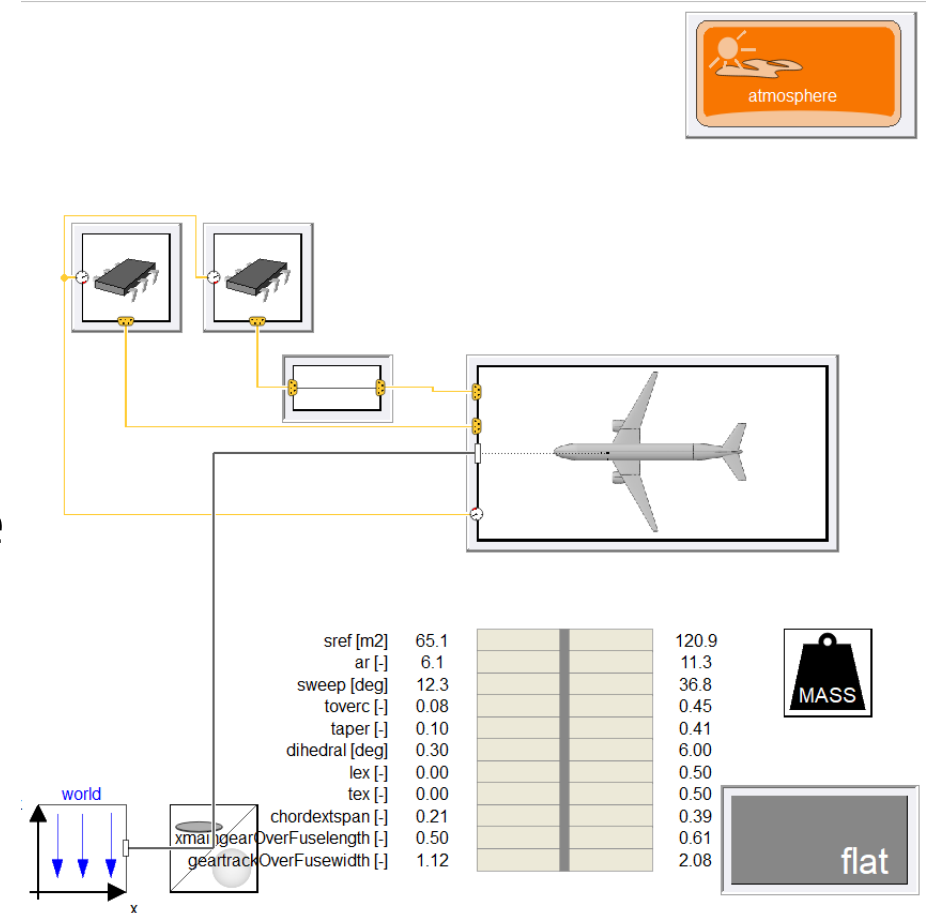
- Aircraft level sizing and synthesis
- Capturing scaling laws on the aircraft level
- Mixing handbook and physics-based models
- Simulating the six degrees of freedom for aircraft dynamics
- Configurable model fidelity for faster simulation and right complexity level.
- Possible to use the library as a pure simulation tool



KEY CAPABILITIES

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- Build models graphically
- Reconfigurable model template
- Robust wing sizing methods
- Variable fuel analysis
- Quasi-static rig test benches
- Compatible with other Modelon libraries for aerospace solutions



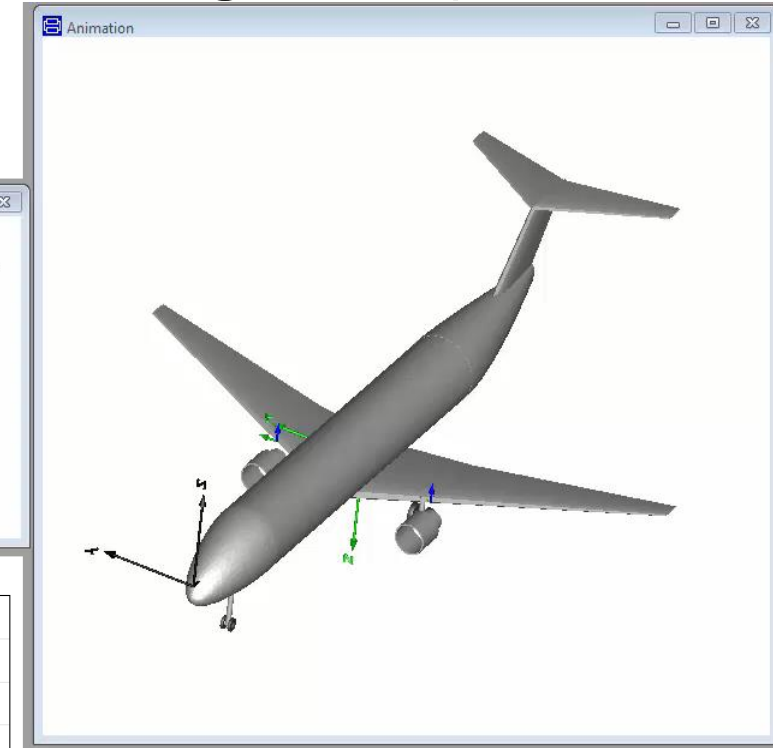
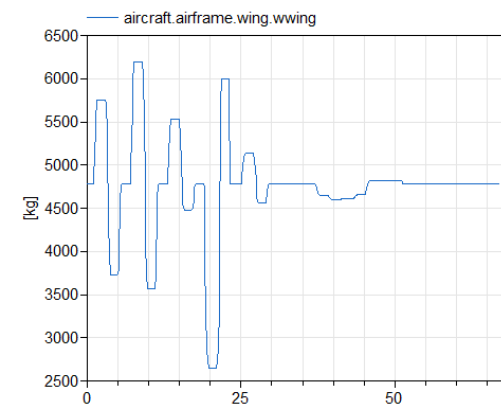
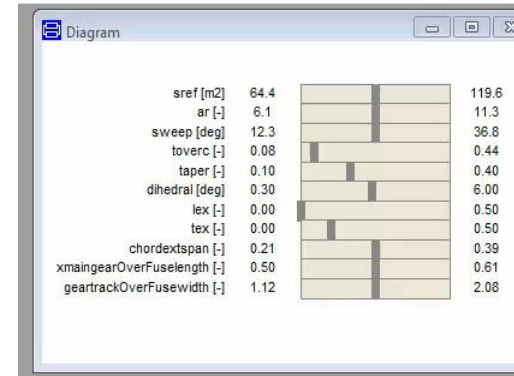


KEY APPLICATIONS

WING SIZING

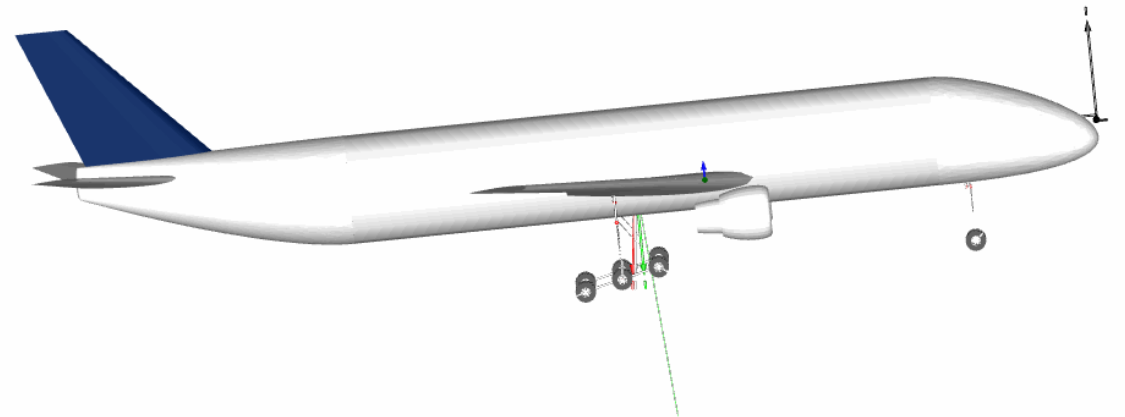
Douglas DC-9 aircraft rigged to a test bench with key scalar variables used to define the geometry. This focus is to only change scalars that define the wing's geometry and observe the effect on the entire aircraft. Changing one of the scalar values, the other scalars are adjusted based on a set of equations in the component. The wing's mass changes with geometry.

Example: Typical wing input parameters and classic geometry relations



LANDING MANEUVER

This example demonstrates the contact between wheels and the runway. Applying the brakes will affect airframe posture and load on the wheels. The aircraft system including landing systems is interesting for several analyses, such as behavior evaluation, controls validation, and system design decisions.



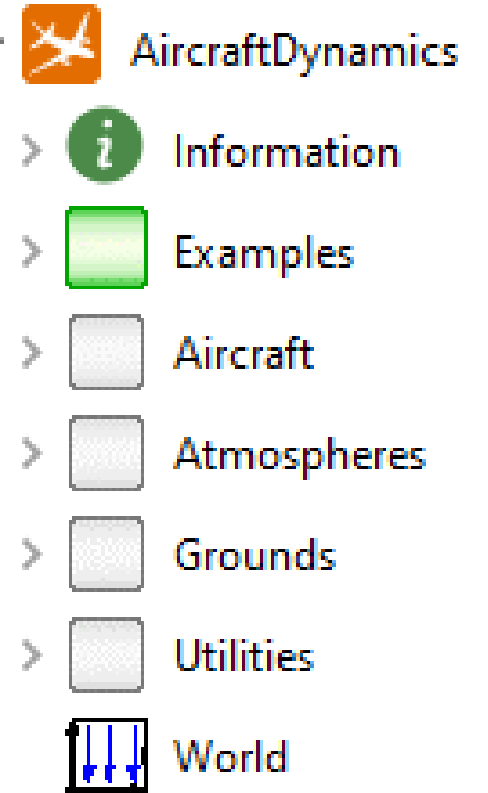


LIBRARY CONTENTS

COMPONENTS

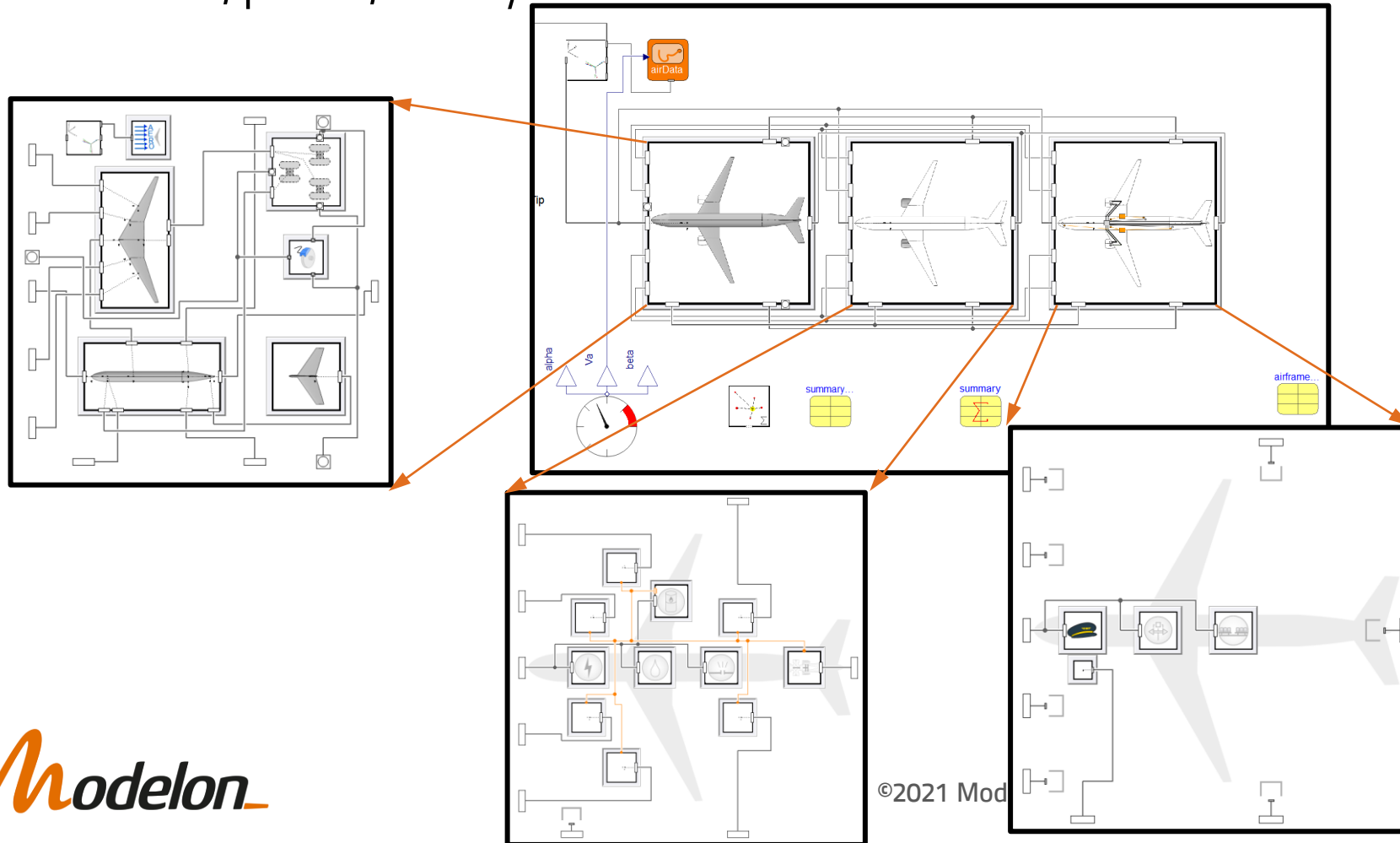
The library is divided into a number of sub-packages for different component types. In each package, components are readily available for use in system models.

- **Examples:** This package contains experiments that demonstrate the use of the components found in this library.
- **Aircraft:** This package contains aircraft system models, built from an airframe, power, and systems sub-models.
- **Atmospheres:** Contains sensors to measure atmosphere conditions.
- **Utilities:** Models that are used throughout the library such as icons, visualizers, and functions.
- **World:** Component that represents the global coordinate system fixed in ground.



COMPONENTS

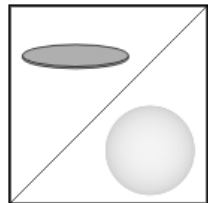
Aircraft: This package contains aircraft system models, built from an airframe, power, and systems sub-models.



- ▼ Aircraft
 - > Experiments
 - > Interfaces
 - > Templates
 - > Airframes
 - > Power
 - > Systems
 - > ControlUnits
 - > Records
 - > Shevell
 - > Examples

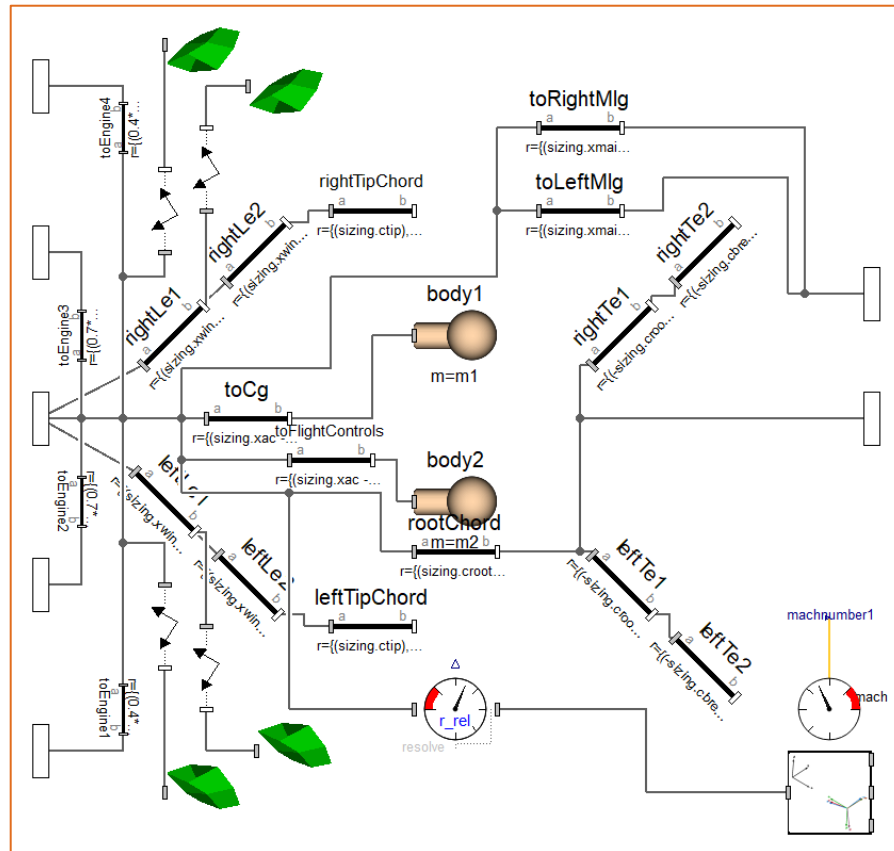
COMPONENTS

- **Atmosphere:** contains the functions that are used to describe different physical relations of the air. They can be selected from functions, e.g.
 - height dependent temperature
 - pressure profiles
 - prescribed by user input functions
 - prescribed as constants
 - supplied via an input that can be connected to other models.
- **MassUpdate:** The component defines the global update of masses used in sizing methods.
- **WorldRepresentation:** These components determine whether the world is defined as
 - flat and position needs to be defined by a Cartesian coordinate system with x,y,z coordinates
 - sphere with geographic coordinates, latitude, longitude and altitude



COMPONENTS

Utilities: Models that are used throughout the library such as icons, visualizers, and functions.



- ▼ Utilities
- > Actuators
- > Mass
- > Blocks
- > Icons
- > MultiBody
- > Visualizers
- > CoordinateSystems
- > Sliders
- > Busses
- > Constants
- > Types
- > Records



MODELON COMPATIBILITY

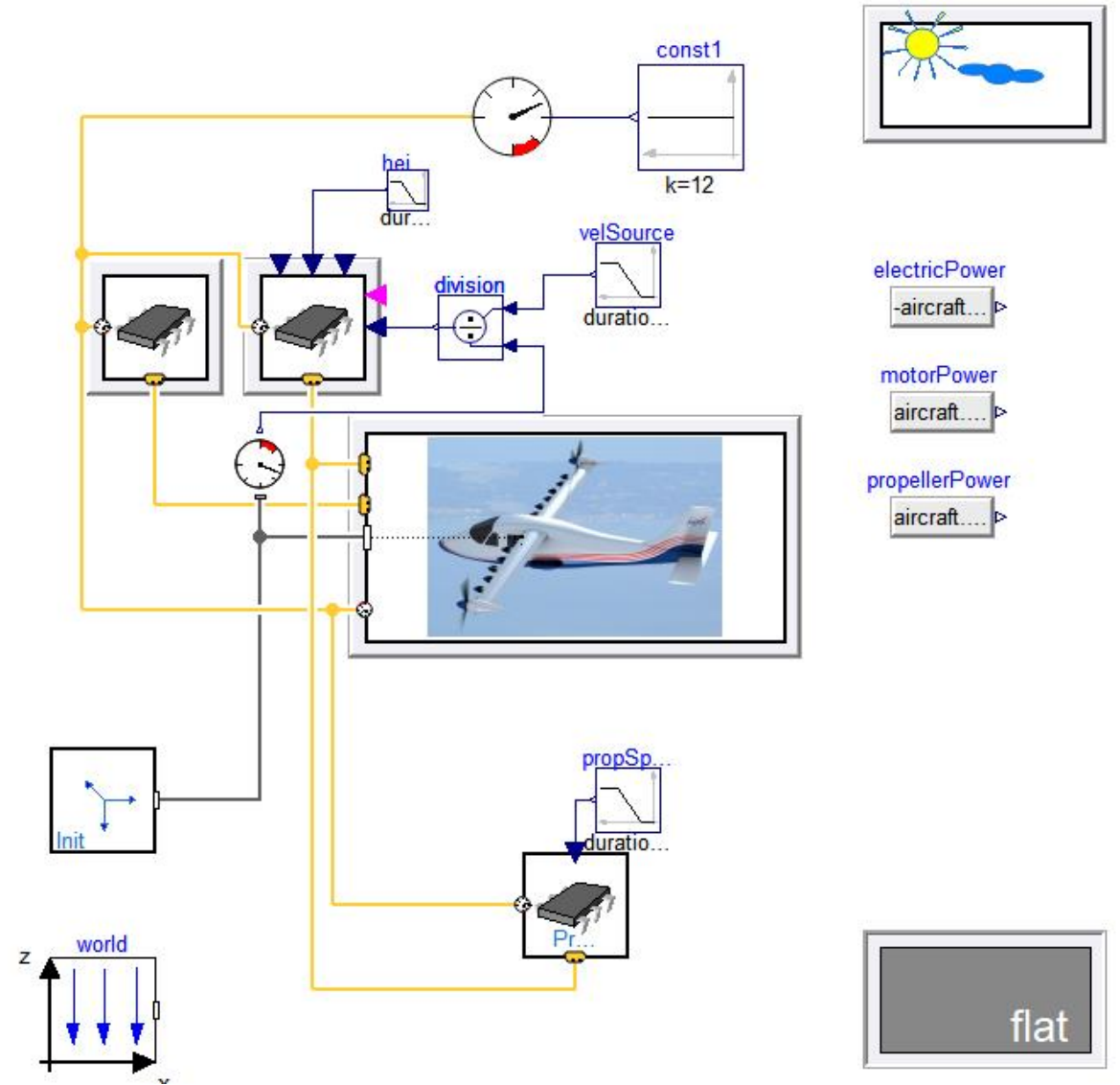
RECOMMENDED MODELON LIBRARY COMPATIBILITY

- Aircraft Dynamics Library can be combined with other Modelon libraries to solve specific engineering design tasks.
- Interesting libraries for aerospace solutions include the
 - Environmental Control Library
 - Fuel System Library
 - Hydraulics Library
 - Pneumatics Library
 - Electrification Library
 - Electric Power Library.
- These libraries can also be used as a stand-alone solution.

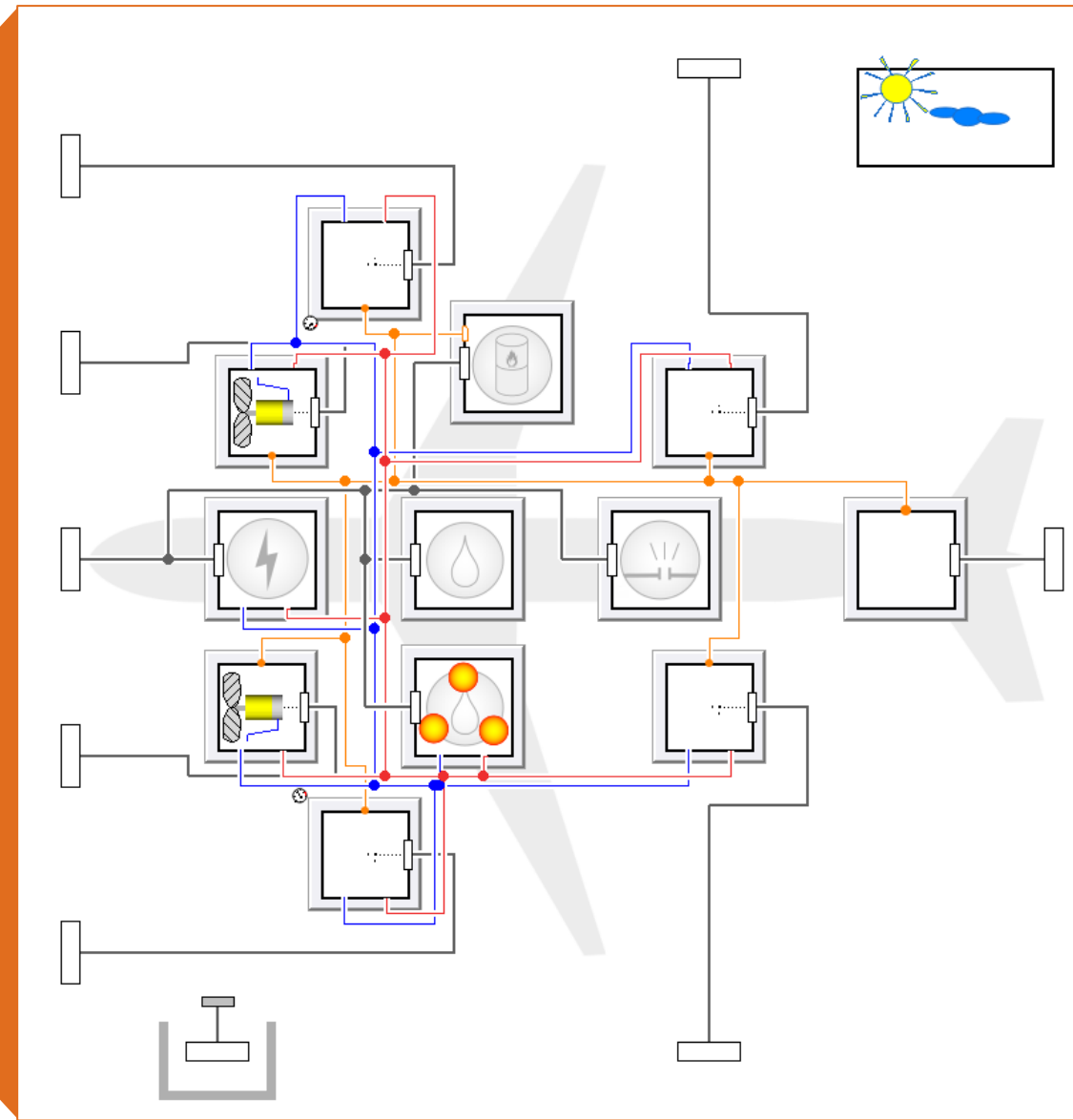
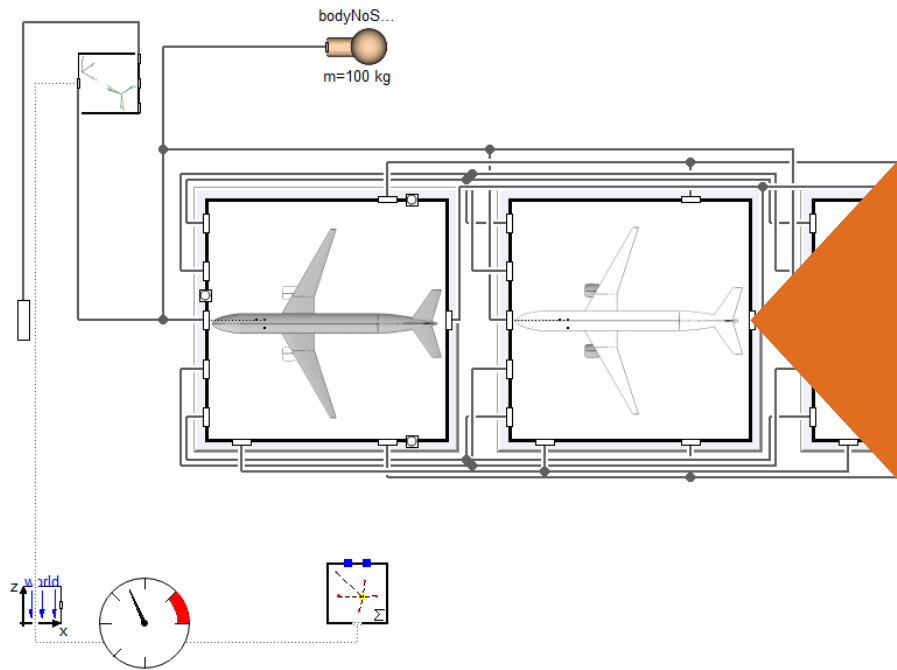


ELECTRIC AIRCRAFT: ADL - EL - LCL INTERACTION

Electric aircraft architecture design and performance evaluation using Aircraft Dynamics Library. The electric propulsion is built with Electrification Library using Liquid Cooling Library for thermal management



POWER TEMPLATE



The background image is a dark, semi-transparent composite. On the left, a person is seen from the side, focused on a laptop. On the right, a large, detailed jet engine turbine is visible. The overall tone is professional and technical.

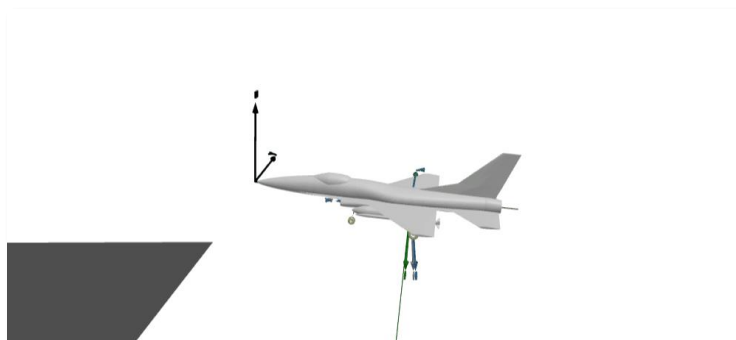
LATEST RELEASE



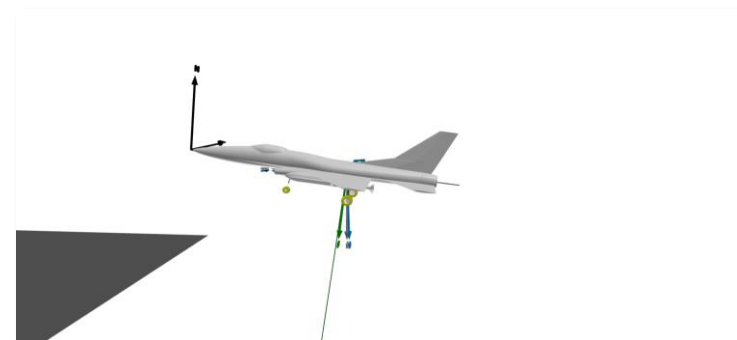
RELEASE: 2021.2

New features

- Complex (multiphysics, multilibrary) high performance aircraft landing digital twin example added into Aircraft Dynamic Library
 - Go-around & landing maneuvers
 - It is built up from **6 Modelon Libraries** (ADL, JPL, EL, FSL, HL, PL)
 - Landing with simple and complex fuel tank



Balked (Cancelled) Landing



Landing



RELEASE: 2021.2

Enhancements

- Common ambient component developed for aerospace libraries are now available in Modelon Base Library 



Atmosphere

- The massCalculation parameter has been moved to a new class MassUpdate which was previously in the WorldRepresentation
- Relative Humidity "phi" as a parameter has been removed from Atmosphere models and has been set to a constant value of '0.1'