

Aerospace Blockset™ Release Notes



MATLAB® & SIMULINK®



How to Contact MathWorks



Latest news: www.mathworks.com
Sales and services: www.mathworks.com/sales_and_services
User community: www.mathworks.com/matlabcentral
Technical support: www.mathworks.com/support/contact_us



Phone: 508-647-7000



The MathWorks, Inc.
1 Apple Hill Drive
Natick, MA 01760-2098

Aerospace Blockset™ Release Notes

© COPYRIGHT 2003–2022 by The MathWorks, Inc.

The software described in this document is furnished under a license agreement. The software may be used or copied only under the terms of the license agreement. No part of this manual may be photocopied or reproduced in any form without prior written consent from The MathWorks, Inc.

FEDERAL ACQUISITION: This provision applies to all acquisitions of the Program and Documentation by, for, or through the federal government of the United States. By accepting delivery of the Program or Documentation, the government hereby agrees that this software or documentation qualifies as commercial computer software or commercial computer software documentation as such terms are used or defined in FAR 12.212, DFARS Part 227.72, and DFARS 252.227-7014. Accordingly, the terms and conditions of this Agreement and only those rights specified in this Agreement, shall pertain to and govern the use, modification, reproduction, release, performance, display, and disclosure of the Program and Documentation by the federal government (or other entity acquiring for or through the federal government) and shall supersede any conflicting contractual terms or conditions. If this License fails to meet the government's needs or is inconsistent in any respect with federal procurement law, the government agrees to return the Program and Documentation, unused, to The MathWorks, Inc.

Trademarks

MATLAB and Simulink are registered trademarks of The MathWorks, Inc. See www.mathworks.com/trademarks for a list of additional trademarks. Other product or brand names may be trademarks or registered trademarks of their respective holders.

Patents

MathWorks products are protected by one or more U.S. patents. Please see www.mathworks.com/patents for more information.

R2022b

Orbit Propagator and Spacecraft Dynamics blocks support atmospheric drag	1-2
Additional Orbit Propagator Mass Parameters	1-2
Support for Cesium plugin	1-2
Simulation 3D Aircraft block changes	1-2
Griffiss International Airport map lighting change	1-3
Simulation 3D Scene Configuration: Use new MATLAB API to download maps locally from the server	1-3
Support Package Installation: Use copyExampleSim3DProject to configure environment for scene customization	1-3
Incidence, Sideslip, & Airspeed updated to reduce divide by zero issues	1-4

R2022a

Simulation 3D Aircraft block support for custom meshes and aircraft lighting	2-2
Simulation 3D Environment Upgrade: Run 3D simulations using Unreal Engine 4.26	2-2
Support for the Underspecified data types configuration parameter	2-2
FlightGear Preconfigured 6DoF Animation pace change	2-2

R2021b

New Spacecraft Dynamics block	3-2
--	-----

New simulation 3D blocks to visualize simulations and communicate with the Unreal Engine 3D visualization environment	3-2
Use support package to customize and install additional 3D scenes	3-3
3DOF equations of motion block changes	3-3
Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks updated	3-3
Decimal day values	3-3
Day values outside 1 to 366 days	3-3
Negative second values	3-3
Orbit Propagator block update	3-4
CubeSat Vehicle Model and CubeSat Simulation Project change	3-4
Functionality being removed or changed	3-4
3DOF equations of motion block changes	3-4
Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks possible changed returned values	3-4

R2021a

CubeSat Simulation Library is now part of Aerospace Blockset	4-2
New Fixed-Wing Point Mass block	4-2
Enhanced flight control analysis	4-2

R2020b

Orbit Propagator Block: Propagate one or more satellite orbits at varying levels of fidelity	5-2
Attitude Profile Block: Compute rotation to reach desired spacecraft attitude	5-2
New International Geomagnetic Reference Field block	5-2
FlightGear support updates	5-2
Geocentric to Geodetic Latitude and Geodetic to Geocentric Latitude blocks have new parameters and ports	5-3
Geoid Height block change	5-3

Functionality being removed or changed	5-3
International Geomagnetic Reference Field block behavior changes	5-3
ECEF Position to LLA and LLA to ECEF Position blocks change in answers	5-3
Updated aeroiersdata.mat file	5-3

R2020a

World Magnetic Model block support for World Magnetic Model 2020	6-2
Flat Earth to LLA and LLA to Flat Earth block updates	6-2
FlightGear interface supports Version 2019.1	6-2
Geocentric to Geodetic Latitude and Geodetic to Geocentric Latitude function updates	6-2
New Example	6-2

R2019b

New World Magnetic Model block	7-2
FlightGear interface supports Version 2018.3	7-2
CubeSat Simulation Library Add-On Updates	7-3

R2019a

Flight control analysis tools updated to support lateral-directional flying quality analysis of aerospace vehicles	8-2
CubeSat Simulation Library to model, simulate, and visualize the motion and dynamics of CubeSats	8-2
FlightGear interface supports Version 2018.2	8-2

R2018b

Flight Control Analysis Tools: Analyze the dynamic response and flying qualities of aerospace vehicles	9-2
Earth Orientation Parameters: Calculate polar motion, adjustment to displacement of celestial intermediate pole, and difference between UT1 and UTC	9-2
Supersonic Airspeed Correction: Convert between equivalent, calibrated, or true airspeed	9-3
Equation of Motion State Names: Simplify linearization process by specifying aerospace-specific rigid-body state names	9-3
Simulation Pace block works with Simulink simulation pacing	9-4
FlightGear Interface: Includes support for Version 2018.1 through flight simulator blocks	9-4

R2018a

FlightGear Interface: Includes support for Version 2017.3 through flight simulator blocks	10-2
Wrap states integration for angles in equation of motion blocks	10-2
Tunable Parameters	10-2
Direction cosine matrix validity checks	10-3
Install FlightGear scenery during simulation	10-4
Disable FlightGear shaders	10-4
New Aerospace Blockset templates	10-4

R2017b

Difference Between UT1 and UTC: Calculate time difference with Delta UT1 block according to the IAU2000A reference system	11-2
FlightGear Interface: Includes support for Version 2017.1 through flight simulator blocks	11-2

WGS84 Gravity Model block updates	11-2
Quaternions to Rotation Angles, Rodrigues to Rotation Angles, and Direction Cosine Matrix to Rotation Angles updates	11-2

R2017a

Euler-Rodrigues Blocks: Convert to and from Rodrigues vectors	12-2
FlightGear Interface: Includes support for Version 2016.3 through flight simulator blocks	12-2
3DOF and 6DOF blocks now calculate inertial body accelerations	12-2
Aerospace Blockset Software and MATLAB string	12-3

R2016b

Horizontal Wind Model 14 Block: Calculate meridional and zonal wind components using U.S. Naval Research Laboratory HWM14 model	13-2
Dryden MIL-HDBK-1797B Turbulence Models: Calculate turbulence velocities and angular rates using MIL-HDBK-1797B mathematical representation	13-2
FlightGear Version 2016.1 Support: Interface with FlightGear through flight simulator blocks	13-2
Simulink units and Aerospace Blockset units	13-2
Property Inspector available for Aerospace Blockset blocks	13-2

R2016a

Flight Instruments: Display measurements through standard cockpit instruments	14-2
Quaternion Interpolation: Calculate interpolation between two quaternions	14-2
Simulink Units	14-2

Updated Examples	14-2
FlightGear versions earlier than 2.0 no longer supported	14-2
Unit conversion block precision changes	14-3

R2015aSP1

Bug Fixes

R2015b

FlightGear Versions 3.2 and 3.4 Support: Interface to these FlightGear versions through flight simulator blocks	16-2
International Geomagnetic Reference Field 12 Block: Calculate Earth magnetic field and secular variation	16-2
Tunable Parameters	16-2
Updated examples	16-3

R2015a

Earth-centered inertial to azimuth, elevation, and range block	17-2
Additional ephemerides coefficient support for celestial phenomena blocks	17-2
New World Magnetic Model 2015 block	17-2
Updated Example	17-2

R2014b

Horizontal Wind Model 07 block	18-2
Flight simulator interface block support for FlightGear Version 3	18-2

Additional ephemerides coefficient support for celestial phenomena blocks	18-2
Examples	18-2
Receive net_ctrl Packet from FlightGear data storage change	18-2
Equations of motion 3DOF and 6DOF acceleration values	18-2

R2014a

Blocks to convert between latitude, longitude, altitude and Earth-centered inertial coordinates	19-2
Flight simulator interface block support for FlightGear Version 2.12	19-2
Equations of Motion 3DOF and 6DOF handle large mass changes	19-2
Blocks being removed or changed	19-3
Add ephemeris and geoid data	19-4
New example Simulink project template	19-4

R2013b

Flight simulator interface block support for FlightGear Version 2.10	20-2
Direction Cosine Matrix ECI to ECEF block to convert Earth-Centered Inertial to Earth-Centered Earth-Fixed coordinates	20-2
Julian Date Conversion block to convert specified calendar date to Julian date or modified Julian date	20-2
Latitude inputs outside +90 and -90 degrees	20-2
Phaseout of FlightGear versions earlier than 2.0	20-2

R2013a

Flight simulator interface block support for FlightGear Version 2.8 . . .	21-2
Planetary Ephemeris block to implement position and velocity of Solar System planets	21-2
Earth Nutation block to implement nutation in longitude and obliquity of Earth	21-2
Moon Libration block to implement relative motion attitude of Moon	21-2
Lowest altitude parameter for specifying altitudes below sea level using Lapse Rate Model block	21-2
Updated Demo	21-2

R2012b

Flight simulator interface block support for FlightGear versions 2.4 and 2.6	22-2
Crossover Pilot Model, Precision Pilot Model, and Tustin Pilot Model blocks for modeling human pilots	22-2

R2012a

Updated Actuator Blocks	23-2
Support for Bidirectional Communication Between FlightGear and Simulink	23-2
Blocks and Block Elements Being Removed	23-2
Updated Example	23-2
Using FlightGear Version 2.4.0 with Aerospace Blockset Software	23-2

R2011b

Conversion of Error and Warning Message Identifiers	24-2
Efficient C Code Generation	24-2
Blocks and Block Elements Being Removed	24-2

R2011a

New LLA to Flat Earth Block	25-2
New International Geomagnetic Reference Field 11 Block	25-2
Spherical Harmonic Gravity Model Supports New Planet Model	25-2
Simulink Coder Inlined Code Generation	25-2
Aerospace Blockset Product Now in Simulink Start, Help, and Demos Category	25-2

R2010b

New Geoid Height Block	26-2
FlightGear Version 2.0 with Aerospace Blockset Software	26-2
Blocks and Block Elements Being Removed	26-2

R2010a

New Centrifugal Effect Model Block	27-2
New Spherical Harmonic Gravity Model Block	27-2
New World Magnetic Model 2010 Block	27-2
Demo	27-2
Support for the Simulink For Each Subsystem Block	27-2

R2009b

New Zonal Harmonic Gravity Model Block	28-2
FlightGear Version 1.9.1 with Aerospace Blockset Software	28-2
Using the Send net_fdm Packet to FlightGear Block to Communicate with Simulink Real-Time Applications	28-2

R2009a

Enhanced Invert 3x3 Matrix Block Inverse Calculation	29-2
Saving and Restoring the Complete SimState	29-2
Using FlightGear Version 1.9.0 with Aerospace Blockset Software	29-2

R2008b

FlightGear Version 1.0 with Aerospace Blockset Software	30-2
Updated Aerospace Blockset Blocks	30-2

R2008a

Quaternion Support for the Embedded MATLAB Function Block	31-2
New Aerospace Blockset Demos	31-2
Using FlightGear Version 1.0 with Aerospace Blockset Software	31-2

R2007b

Direction Cosine Matrix to Rotation Angles Block Replaces Direction Cosine Matrix to Euler Angle Block	32-2
---	-------------

Rotation Angles to Direction Cosine Matrix Block Replaces Euler Angle to Direction Cosine Block	32-2
New CIRA-86 Atmosphere Model Block	32-2
New NRLMSISE-00 Atmosphere Model Block	32-2
New EGM96 Geoid Block	32-2
Quaternions to Rotation Angles Block Replaces Quaternions to Euler Angles Block	32-2
Rotation Angles to Quaternions Block Replaces Euler Angles to Quaternions Block	32-3
Enhanced HL-20 Demo	32-3

R2007a

New MATLAB Animation Block	33-2
New Pilot Joystick All Block	33-2
WGS84 Gravity Model Block Modified	33-2
New Aerospace Blockset Demo	33-2

R2006b

Aerospace Toolbox Product Replaces Control System Toolbox Product as Requirement for Aerospace Blockset Product	34-2
Interpolate Matrix Blocks Modified	34-2
Aerodynamic Forces and Moments Block Extended	34-2
New Digital DATCOM Forces and Moments Block	34-2
FlightGear Version 0.9.10 Is Supported by FlightGear Simulator Interface	34-2
Pack net_fdm Packet for FlightGear Now Supports Code Generation ..	34-2
New SimViewingDevice Block	34-3

R2006a

FlightGear Version 0.9.9 Is Supported by FlightGear Simulator Interface	35-2
3DoF Animation and 6DoF Animation Blocks Support Code Generation	35-2

R14SP3

No New Features or Changes

R14SP2+

Flight Simulator Interface	37-2
New Aerospace Blockset Blocks	37-2
Mach Number and Dynamic Pressure Blocks Input	37-4

R14SP2

No New Features or Changes

R2022b

Version: 5.3

New Features

Bug Fixes

Compatibility Considerations

Orbit Propagator and Spacecraft Dynamics blocks support atmospheric drag

To help model the drag on spacecraft for high-precision orbit propagation, the Orbit Propagator and Spacecraft Dynamics blocks now support atmospheric drag. Atmospheric drag affects spacecraft flying at low Earth orbit (LEO). Atmospheric drag is less relevant for spacecraft flying further away from Earth.

To configure the Orbit Propagator and Spacecraft Dynamics blocks for atmospheric drag, on the **Drag** tab, select **Include atmospheric drag**. This selection enables the atmospheric drag configuration parameters.

Additional Orbit Propagator Mass Parameters

For the Orbit Propagator block, to enable **Include atmospheric drag**, set **Propagation method** to **Numerical (high precision)**. When you enable atmospheric drag, two new mass parameters are added to the **Main** tab.

- **Mass source** — Mass source, specified via the **Mass** parameter or through the **m** input port.
- **Mass** — Mass of rigid body spacecraft.

Support for Cesium plugin

Aerospace Blockset can now stream 3D map and terrain data of a location using Cesium[®] ion. Aerospace Blockset uses Unreal Engine[®] to build an executable window that visualizes your simulation and uses Cesium to create a scene for that visualization at runtime. To customize Cesium scenes, download and install the Cesium for Unreal[®] plugin and use the Aerospace Blockset Interface for Unreal Engine Projects.

To support this new capability, the Simulation 3D Scene Configuration block is updated with a new Geospatial tab that you use to connect with Cesium ion for the stream.

For more information on streaming 3D map and terrain data using Cesium, see “Visualize with Cesium”.

Simulation 3D Aircraft block changes

The Simulation 3D Aircraft block has these changes:

- Two generic, customizable aircraft types represent air transport and general aviation aircraft types: `Air transport` and `General aviation`, respectively.
- New mesh path parameters are associated with the `Air transport` and `General aviation` aircraft types:

Type Setting	Mesh Path Parameter
General aviation	Path to general aviation mesh
Air transport	Path to air transport mesh

- Associated with the new `Air transport`, `General aviation`, and `Custom` aircraft types, the block **Light Configuration** tab has been updated with additional light settings:

-
- **Landing lights**
 - **Left landing light location**
 - **Left landing light orientation**
 - **Right landing light location**
 - **Right landing light orientation**
 - **Taxi lights**
 - **Taxi lights location**
 - **Taxi lights orientation**
 - When selecting **Custom**, all light configuration settings are now available when **Light configuration** is set to `Configurable lights`. In previous releases, all light configurations were disabled for custom aircraft types.

Griffiss International Airport map lighting change

The Griffiss International Airport map in the Aerospace Blockset Interface for Unreal Engine Projects support package now has precision approach path indicator (PAPI) lights for runway 33. These lights are always on and guide aircraft during landing.

Simulation 3D Scene Configuration: Use new MATLAB API to download maps locally from the server

Starting in R2022b, you can use the `sim3d.maps` class and its object functions to download prebuilt Unreal Engine scenes and access them directly from the Simulation 3D Scene Configuration block.

- The `sim3d.maps.Map.download` function downloads a map from the server and makes the map locally available.
- The `sim3d.maps.Map.delete` function deletes the map that you download from the server.
- The `sim3d.maps.Map.server` function lists all the maps on the server that are available for download.
- The `sim3d.maps.Map.local` function lists the locally available maps downloaded from the server.

Support Package Installation: Use `copyExampleSim3DProject` to configure environment for scene customization

To configure your environment so that you can customize scenes, install the Aerospace Blockset Interface for Unreal Engine Projects. The support package includes these components:

- An Unreal project, defined in `AutoVrtlEnv.uproject`, and its associated files. The project includes editable versions of the prebuilt 3D scenes that you can select from the **Scene name** parameter of the Simulation 3D Scene Configuration block.
- Three plugins: `MathWorkSimulation`, `RoadRunnerMaterials`, and `MathWorksAerospaceContent`. These plugins establish the connection between MATLAB® and the Unreal Editor and are required for co-simulation.

Starting in R2022b, you can use the `copyExampleSim3dProject` function to copy the support package components to a folder on your local machine. For example, this code copies the files to `C:\project`.

```
sim3d.utils.copyExampleSim3dProject("C:\project");
```

For more information, see “Customize 3D Scenes for Aerospace Blockset Simulations”.

Compatibility Considerations

Previously, the configuration steps to set up the environment were contained in the product documentation. The steps:

- Copied the `MathWorksSimulation`, `RoadRunnerMaterials`, and `MathWorksAerospace` plugin folders to the Unreal plugin folder.

In R2022b, `copyExampleSim3dProject` copies the plugins to a specified folder.

- Copied the support package folder containing the `AutoVrtlEnv.uproject` files to a specified folder.

In R2022b, `copyExampleSim3dProject` also copies the `AutoVrtlEnv.uproject` files to a specified folder.

Incidence, Sideslip, & Airspeed updated to reduce divide by zero issues

The Incidence, Sideslip, & Airspeed block now reduces the potential for divide by zero issues caused by aircraft hovering without forward movement.

R2022a

Version: 5.2

New Features

Bug Fixes

Compatibility Considerations

Simulation 3D Aircraft block support for custom meshes and aircraft lighting

The Simulation 3D Aircraft block now supports:

- The specification of a custom aircraft mesh with the **Path to custom mesh** parameter. To enable this parameter, set **Type** to Custom.
- The configuration of aircraft lighting with a new Light Configuration tab.
- More colors for aircraft bodies in the **Color** parameter.

Simulation 3D Environment Upgrade: Run 3D simulations using Unreal Engine 4.26

The 3D visualization engine that comes installed with Aerospace Blockset has been updated to Unreal Engine 4.26. Previously, the toolbox used Unreal Engine 4.25.

For information about using Unreal Engine to create custom scenes, see [Unreal Engine Simulation Environment Requirements and Limitations](#).

Compatibility Considerations

If your Simulink® model uses an Unreal Engine executable or project developed using a prior release of the Aerospace Blockset Interface for Unreal Engine Projects support package, the simulation may return an error. To migrate the project so that it is compatible with the R2022a version of the support package, see [Install Support Package and Configure Environment](#).

Support for the Underspecified data types configuration parameter

Aerospace Blockset models now support the Underspecified data types configuration parameter. This setting lets you select the diagnostic action to take if the software cannot infer the data type of a signal during data type propagation.

FlightGear Preconfigured 6DoF Animation pace change

The **Sleep mode** parameter of the Simulation Pace block used in the FlightGear Preconfigured 6DoF Animation block has been changed from MATLAB Thread to Auto. This change lets the block use the model configuration parameter setting **Enable pacing to slow down simulation** to control the simulation pace. In previous releases, the block used the operating system `sleep` function during simulation to wait for the wall clock to get to time 1. There is no behavior change.

R2021b

Version: 5.1

New Features

Bug Fixes

Compatibility Considerations

New Spacecraft Dynamics block

The new Spacecraft Dynamics block computes the position, velocity, attitude, and angular velocity of one or more spacecraft over time. This block combines the translational dynamics modeling of the Orbit Propagator block with rotational dynamics modeling. Use this block to:

- Simulate rigid-body translational and rotational dynamics of a spacecraft or constellation.
- Model station-keeping and attitude maneuvers.

The Spacecraft Dynamics block also supports scalar and vector expansion of block parameters and input ports. The block parameter dimensions in the **Orbit**, **Mass**, and **Attitude** tabs determine the number of spacecraft being modeled and the size of the output signals. When modeling more than one spacecraft in the block, all parameters in the **Orbit**, **Mass**, and **Attitude** tab and all input ports except for $\varphi\theta\psi$ (Moon libration angles) and $\alpha\delta W$ (right ascension, declination, and rotation angle) must provide values for each unique spacecraft, or a single value to apply to all spacecraft modeled.

New simulation 3D blocks to visualize simulations and communicate with the Unreal Engine 3D visualization environment

Aerospace Blockset now supports 3D simulation rendered using Unreal Engine from Epic Games®. This support enables you to:

- Add Aerospace Blockset aircraft into Unreal Engine scenes for co-simulation. The aircraft can be an airliner or small general aviation aircraft with altitude and weight-on-wheels sensors.
- Use an airport map with a control tower and hangar.
- Control scene weather and sun position using the Simulation 3D Scene Configuration block.

For more information, see these blocks, available in the **Aerospace Blockset > Animation > Simulation 3D** sublibrary:

- Simulation 3D Actor Transform Get — Get actor translation, rotation, scale
- Simulation 3D Actor Transform Set — Set actor translation, rotation, scale
- Simulation 3D Aircraft — Implement aircraft in 3D environment
- Simulation 3D Camera Get — Camera image
- Simulation 3D Scene Configuration — Configure scene for 3D simulation environment
- Simulation 3D Message Get — Retrieve data from Unreal Engine visualization environment
- Simulation 3D Message Set — Send data to Unreal Engine visualization environment

Also see these functions and objects:

- `sim3d.Editor` — Interface to the Unreal Engine project
- `open` — Open the Unreal Editor
- `ASim3dActor` — Abstract class to use as a base class for user-defined Unreal Engine C++ or blueprint actors
- `Sim3dSetup` — C++ method that sets up actor in Unreal Engine 3D simulation
- `Sim3dStep` — C++ method that steps actor in Unreal Engine 3D simulation
- `Sim3dRelease` — C++ method that releases actor in Unreal Engine 3D simulation

-
- `StartSimulation3DMessageReader` — Constructs a message reader object in the Unreal Engine
 - `ReadSimulation3DMessage` — Receives message from Simulink model using a message reader object
 - `StopSimulation3DMessageReader` — Deletes message reader object in the Unreal Editor
 - `StartSimulation3DMessageWriter` — Constructs a message writer object in the Unreal Editor
 - `WriteSimulation3DMessage` — Sends message to Simulink model using a message writer object
 - `StopSimulation3DMessageWriter` — Deletes message writer object in the Unreal Editor

Use support package to customize and install additional 3D scenes

The Aerospace Blockset Interface for Unreal Engine Projects support package provides a preconfigured Unreal Engine project and maps that you can customize. By default, the package contains the Griffiss International Airport map. With this support package, you can co-simulate with the Unreal Engine editor and create standalone games.

3DOF equations of motion block changes

The 3DOF equations of motion blocks have these changes:

- New **Axes** parameter, preselected to the correct axes for the block.
- New check box **Limit mass flow when mass is empty or full** when **Mass type** is set to **Simple Variable**.
- Support that enables 3DOF equations of motion blocks to be contained in For Each Subsystem blocks.
- The order of block parameters has changed.

Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks updated

The Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks have been updated to better handle day and second values.

Decimal day values

The Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks now accept decimal day values. In previous releases, these blocks floored day values, ignoring partial days.

Day values outside 1 to 366 days

The Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks now use day values outside the range 1 to 366 days when the **Action for out-of-range input** parameter is set to **Warning** or **None**. In previous releases, the Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks used 1 for the **day** port value when the **day** value was negative or 0 and used 366 for the **day** port value when the value exceeded 366.

Negative second values

The Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks now use second values outside the range 0 to 86400 seconds when the **Action for out-of-range input** parameter is set to **Warning**

or None. In previous releases, the Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks used 0 for the **sec** port value when the **sec** value was negative and used 86400 for the **sec** port value when the value exceeded 86400.

Orbit Propagator block update

The Orbit Propagator block now supports scalar and vector expansion. The block parameter and input port dimensions determine the number of the output signals and the number of spacecraft. After scalar and vector expansion, all parameters in the **Orbit** tab and the \mathbf{A}_{icrf} (applied acceleration) input port are defined for each spacecraft.

CubeSat Vehicle Model and CubeSat Simulation Project change

For the CubeSat Vehicle Model template and CubeSat Simulation Project available from the Simulink Start Page, the default orientation of the CubeSat object in the Simulink 3D Animation™ Viewer has been rotated 90 degrees about the body z-axis from its previous position. This change affects you only if you have a Simulink 3D Animation license.

Functionality being removed or changed

3DOF equations of motion block changes

Behavior change

The 3DOF equations of motion have been updated. Existing models created prior to R2021b that contain 3DOF equations of motion blocks continue to run. If you replace a pre-R2021b version of a 3DOF equation of motion block with an R2021b or later version, your updated model might have a higher tendency for algebraic loops. For an example of how to remove algebraic loops using unit delays, see [Remove Algebraic Loops](#). For further information about algebraic loops, see [Identify Algebraic Loops in Your Model](#).

Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks possible changed returned values

Behavior change

The Horizontal Wind Model 07 and Horizontal Wind Model 14 blocks now accept:

- **day** port values that are decimal, negative, 0, or greater than 366.
- **sec** port values that are 0 or greater than 86400.

As a result, the output values from these blocks might change from previous releases.

R2021a

Version: 5.0

New Features

Bug Fixes

Compatibility Considerations

CubeSat Simulation Library is now part of Aerospace Blockset

The CubeSat Simulation Library Add-On, which includes blocks and supporting functions, is no longer an add-on. Instead, the block sublibrary is now integrated into the Aerospace Blockset and Aerospace Toolbox products.

Compatibility Considerations

The CubeSat Simulation Library Add-On, which includes blocks and supporting functions, is no longer an add-on.

Existing models created prior to R2021a that contain CubeSat Vehicle, Orbit Propagator, and Attitude Profile blocks continue to run.

Differences are:

- The CubeSat Vehicle now propagates in the ECI coordinate frame using Earth orientation parameters data from the `aeroiersdata.mat` file. Results differ, but are more accurate than with previous versions of the block.
- The Attitude Profile and Orbit Propagator blocks are now in the **Aerospace Blockset > Spacecraft > Spacecraft Dynamic** sublibrary and the CubeSat Vehicle block is now in the **Aerospace Blockset > Spacecraft > CubeSat Vehicles** sublibrary.
- `asbCubeSatMissionAnalysis` — See Mission Analysis with the Orbit Propagator Block.
- `generateAccessTable` — No longer available. See `accessIntervals`.
- These functions have moved to Aerospace Toolbox:
 - `ecef2eci`
 - `eci2ecef`
 - `ijk2keplerian`
 - `keplerian2ijk`
- This function is no longer recommended:
 - `greenwichSRT` — Not recommended. Use `siderealTime` instead.

New Fixed-Wing Point Mass block

The Fixed-Wing Point Mass block integrates fourth- or sixth-order fixed-point mass equations of motion in coordinated flight.

Enhanced flight control analysis

The Aerospace Blockset enhances flight control analysis with support for MIL-STD-1797A. The `computeLongitudinalFlyingQualities` and `computeLateralDirectionalFlyingQualities` functions have been updated to reflect this support.

R2020b

Version: 4.4

New Features

Bug Fixes

Compatibility Considerations

Orbit Propagator Block: Propagate one or more satellite orbits at varying levels of fidelity

To propagate one or more satellite orbits at varying levels of fidelity, use the Orbit Propagator block. This block integrates equations of motion using Earth-centered inertial (ECI) coordinates. In contrast, the CubeSat Vehicle blocks uses Earth-centered Earth-fixed CubeSat coordinates and propagates one satellite orbit at a time.

Note This block is available only through the CubeSat Simulation Library Add-On (Version 20.2 onward).

To start the Add-On Explorer for aerospace Add-Ons, use the `asbAddOns` function. For more information, see Reference Applications.

Attitude Profile Block: Compute rotation to reach desired spacecraft attitude

To calculate the shortest quaternion rotation that aligns the primary alignment vector with the primary constraint vector for spacecraft, use the Attitude Profile block.

Note This block is available only through the CubeSat Simulation Library Add-On (Version 20.2 onward).

To start the Add-On Explorer for aerospace Add-Ons, use the `asbAddOns` function. For more information, see Reference Applications.

New International Geomagnetic Reference Field block

The new International Geomagnetic Reference Field block lets you use one block to access all supported International Geomagnetic Reference Field (IGRF) models (IGRF-11, IGRF-12, and IGRF-13). Support for the IGRF-13 model is new for R2020b.

The International Geomagnetic Reference Field block replaces the International Geomagnetic Reference Field 12.

Existing models that contain the International Geomagnetic Reference Field 12 block continue to work as before. Consider replacing the International Geomagnetic Reference Field 12 with the new International Geomagnetic Reference Field block. For the changes between the two blocks, see “International Geomagnetic Reference Field block behavior changes” on page 5-3.

FlightGear support updates

Aerospace Blockset FlightGear blocks no longer require you to specify particular FlightGear versions. Aerospace Blockset supports FlightGear versions starting at V2.6. As a result, the **FlightGear version** parameter has been removed from these blocks:

- FlightGear Preconfigured 6DoF Animation
- Pack `net_fdm` Packet for FlightGear

-
- Receive net_ctrl Packet from FlightGear
 - Unpack net_ctrl Packet from FlightGear

Geocentric to Geodetic Latitude and Geodetic to Geocentric Latitude blocks have new parameters and ports

The Geocentric to Geodetic Latitude block has a new parameter, **Output altitude**, which enables the output of the mean sea-level altitude (MSL) through the new **h** port.

The Geodetic to Geocentric Latitude has a new parameter, **Output radius**, which enables the output of the radius from the center of the planet to the center of gravity, through the new **r** port.

Geoid Height block change

Starting in R2020b, input a geodetic latitude for the Geoid Height μ port. In previous releases, you were directed to input a geocentric latitude to the λ port. Using a geodetic latitude might output different results.

Functionality being removed or changed

International Geomagnetic Reference Field block behavior changes

Behavior change

The International Geomagnetic Reference Field block replaces the International Geomagnetic Reference Field 12 block. Existing models that contain the International Geomagnetic Reference Field 12 block continue to work as before. Consider replacing the International Geomagnetic Reference Field 12 block with the International Geomagnetic Reference Field.

In addition to support for the IGRF-13 model, these changes have been introduced:

- Results of the model might differ from previous models containing the International Geomagnetic Reference Field 12 block
- The model allows higher height values to 5.6 Earth radii (35,717,567.2 m). Previously, this value was 600,000 m.
- The model allows a wider range of latitude values (greater than 90, less than -90). When approaching the poles, the function generates more accurate data than with the function from previous releases. The International Geomagnetic Reference Field block no longer generates NaNs when input values approach the poles.
- The model allows wider range of longitude values (greater than 180, less than -180).

ECEF Position to LLA and LLA to ECEF Position blocks change in answers

Behavior change

The ECEF Position to LLA and LLA to ECEF Position blocks are no longer fixed in minor step. As a result, for minor steps of a simulation, numerical answers might be more accurate than from previous results.

Updated aeroiersdata.mat file

Behavior change

The contents of the `aeroiersdata.mat` file have been updated. Correspondingly, the output of the Earth Orientation Parameters and Delta UT1 blocks will have different results when using the default

value ('aeroiersdata.mat') as the value of the **IERS data file** parameter. The results reflect more accurate external data from the International Earth Rotation and Reference Systems Service (IERS).

R2020a

Version: 4.3

New Features

Bug Fixes

Compatibility Considerations

World Magnetic Model block support for World Magnetic Model 2020

The World Magnetic Model block now supports the World Magnetic Model 2020 by default.

Flat Earth to LLA and LLA to Flat Earth block updates

The Flat Earth to LLA and LLA to Flat Earth blocks have a new parameter, **Input reference position and orientation**, which enables two input ports:

- μ_{ref} l_{ref}
- ψ_{ref}

Use these ports to specify the reference position and direction of the flat Earth x-axis as varying values rather than static ones.

FlightGear interface supports Version 2019.1

The Aerospace Blockset product now supports FlightGear v2019.1.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

Geocentric to Geodetic Latitude and Geodetic to Geocentric Latitude function updates

The Geocentric to Geodetic Latitude and Geodetic to Geocentric Latitude blocks no longer use a low altitude approximation.

Compatibility Considerations

The Geocentric to Geodetic Latitude and Geodetic to Geocentric Latitude blocks no longer use a low altitude approximation. This change results in geodetic latitude (Geocentric to Geodetic Latitude) and geocentric latitude (Geodetic to Geocentric Latitude) output being more accurate at higher altitudes than in previous releases.

New Example

Electrical Component Analysis for Hybrid and Electric Aircraft — New example that illustrates how to use modeling for rapid exploration of design space in the hybrid and electric aircraft area and compare the results to design criteria. Using preconfigured and customizable aircraft, this example shows the tradeoffs between battery sizes for a pure electric or hybrid electric power system, with and without payloads.

R2019b

Version: 4.2

New Features

Bug Fixes

New World Magnetic Model block

The new World Magnetic Model block lets you choose the World Magnetic Model coefficient file to calculate the Earth magnetic field. In the case of World Magnetic Model 2015, the new World Magnetic Model block uses the World Magnetic Model 2015v2 (WMM2015v2) coefficient file by default.

WMM2015v2 supersedes WMM2015(v1). Consider replacing WMM2015(v1) with WMM2015v2 when used for navigation and other systems. WMM2015v2 was released by NOAA in February, 2019 to correct performance degradation issues in the Arctic region for January 1, 2015 to December 31, 2019. Therefore, it is still acceptable to use WMM2015(v1) in systems below 55-degrees latitude in the Northern hemisphere.

The World Magnetic Model replaces these blocks:

- World Magnetic Model 2000
- World Magnetic Model 2005
- World Magnetic Model 2010
- World Magnetic Model 2015

Existing models that contain World Magnetic Model 2000, World Magnetic Model 2005, and World Magnetic Model 2010 blocks continue to work as before. If you run or open a model that contains a World Magnetic Model 2015 block, Aerospace Blockset replaces that block with World Magnetic Model and uses the WMM2015v2 coefficient file.

FlightGear interface supports Version 2018.3

The Aerospace Blockset product now supports FlightGear v2018.3.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

If you do not download scenery in advance, you can direct FlightGear to download it automatically during simulation using the **Install FlightGear scenery during simulation (requires Internet connection)** parameter of the Generate Run Script block.

Starting with FlightGear v2018.3 on Windows® systems, you may encounter an error message while launching FlightGear with the InstallScenery option enabled:

```
Error creating directory: No such file or directory
```

This error likely indicates that your default FlightGear download folder is not writeable, the path cannot be resolved, or the path contains UNC path names. To work around the issue, edit the `runfg.bat` file to specify a new folder path to store the scenery data:

- 1 Edit `runfg.bat`.
- 2 To the list of command options, append `--download-dir=` and specify a folder to which to download the scenery data. For example:

```
--download-dir=C:\Users\user1\Documents\FlightGear
```

All data downloaded during this FlightGear session is saved to the specified directory. To avoid downloading duplicate scenery data, use the same directory in succeeding FlightGear sessions

- 3 To open FlightGear, run `runfg.bat`.

Note Each time that you run the Generate Run Script block, it creates a new script. It overwrites any edits that you have added.

CubeSat Simulation Library Add-On Updates

The CubeSat Simulation Library Add-On has these updates:

- Support for mission analysis in the CubeSat Vehicle block, including the capability to generate a mission analysis report as a live script.
- Functions to support the mission analysis capability:
 - `asbCubeSatMissionAnalysis` — Create and launch CubeSat Mission Analysis live script
 - `generateAccessTable` — Calculate LOS mutual visibility between CubeSat and ground station

To start the Add-On Explorer for aerospace Add-Ons, use the `asbAddOns` function. For more information, see [CubeSats](#).

R2019a

Version: 4.1

New Features

Bug Fixes

Flight control analysis tools updated to support lateral-directional flying quality analysis of aerospace vehicles

The Aerospace Blockset product provides templates and tools to analyze lateral-directional dynamic response and flying qualities of aerospace vehicles. These tools require the Simulink Control Design™ software. To support the analysis of lateral-directional flying qualities of aerospace vehicles, these tools have been updated:

Tool	Description
<code>computeLateralDirectionalFlyingQualities</code>	New function to compute lateral-directional flying qualities (roll, spiral, dutch roll modes) using a linear system state-space model.
<code>linearizeLongitudinalAirframe</code>	Name changed to <code>linearizeAirframe</code> .
<code>DehavillandBeaverLongitudinalFlyingQualityAnalysis.mlx</code>	Name changed to <code>DehavillandBeaverFlyingQualityAnalysis.mlx</code> .

For more information, see [Analyze Dynamic Response and Flying Qualities of Aerospace Vehicles](#).

CubeSat Simulation Library to model, simulate, and visualize the motion and dynamics of CubeSats

The CubeSat Simulation Library for Aerospace Blockset lets you model, simulate, analyze and visualize the motion and dynamics of CubeSats. To get started with CubeSat simulations, the library provides a ready-to-simulate example of a CubeSat modeled in Simulink with template models. These templates are available from the Simulink Start page. To help you get started modeling vehicle motion and dynamics, the library also includes a CubeSat Simulink block featuring orbit propagation and attitude control. To open the CubeSat block library, at the MATLAB Command Window, type `asbCubeSatBlockLib`.

Install the CubeSat Simulation Library as an add-on using the Add-On Explorer in the MATLAB desktop. Use the search term "CubeSat" in the Add-On Explorer to find and install the library.

FlightGear interface supports Version 2018.2

The Aerospace Blockset product now supports FlightGear v2018.2.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack `net_fdm` Packet for FlightGear
- Receive `net_ctrl` Packet from FlightGear
- Unpack `net_ctrl` Packet from FlightGear

R2018b

Version: 4.0

New Features

Bug Fixes

Compatibility Considerations

Flight Control Analysis Tools: Analyze the dynamic response and flying qualities of aerospace vehicles

The Aerospace Blockset product provides templates and tools to analyze dynamic response and flying qualities of aerospace vehicles. These tools require the Simulink Control Design software.

- Use airframe templates to architect aircraft models for step-by-step analysis workflow
- Compute and analyze flying qualities of aircraft models via command line functions
- See live script examples of flying quality analysis with detailed explanation

The flight control analysis tools include:

Tools		Description
Models	<code>flightControl3DOFAirframeTemplate</code> <code>flightControl6DOFAirframeTemplate</code>	Models used during the flying quality analysis. These models are configured for linearization and handling quality analysis. These models provide step-by-step workflows to perform flying quality analysis.
Live scripts	<code>SkyHoggLongitudinalFlyingQualityAnalysis</code> <code>DehavillandBeaverLongitudinalFlyingQualityAnalysis</code>	Live scripts that illustrate the flying quality analysis workflow.
Functions	<code>asbFlightControlAnalysis</code> <code>trimAirframe</code> <code>linearizeLongitudinalAirframe</code> <code>computeLongitudinalFlyingQualities</code>	<p>Functions that the models use during the flying quality analysis workflow.</p> <p>To create a new model from these templates, use the <code>asbFlightControlAnalysis</code> function.</p>

For more information, see [Analyze Dynamic Response and Flying Qualities of Aerospace Vehicles](#).

Earth Orientation Parameters: Calculate polar motion, adjustment to displacement of celestial intermediate pole, and difference between UT1 and UTC

The Earth Orientation Parameters block calculates these earth orientation parameters:

- Difference between the UTC and Universal Time (UT1)
- Polar displacement of the Earth
- Adjustment to the location of the Celestial Intermediate Pole (CIP)

Supersonic Airspeed Correction: Convert between equivalent, calibrated, or true airspeed

The Ideal Airspeed Correction block has been updated to now also work with supersonic airspeeds (greater than Mach 1). The block also now lets you choose a method for computing the conversion factor (table lookup or compute on demand). As a result, code generation may take longer than in previous releases.

Starting in the R2018b Update 3 release, to give you more control over generated code, the Ideal Airspeed Correction block has added this parameter:

- **Subsonic airspeeds only** — Specify that the Ideal Airspeed Correction block is to be used only for subsonic (Mach < 1) applications. This check box simplifies the behavior of the block and can improve performance.

This change allows Simulink models and generated code to include one of:

- No lookup table data if **Method** is set to Equation
- Subsonic (Mach < 1) lookup table data if **Method** is set to Table Lookup and **Subsonic airspeeds only** check box is selected
- All (Mach < 5) lookup table data if **Method** is set to **Table Lookup** and **Subsonic airspeeds only** check box is cleared

Compatibility Considerations

The Ideal Airspeed Correction block output may differ from the previous version of the block.

For a potentially more accurate output, consider using the Equation method.

Equation of Motion State Names: Simplify linearization process by specifying aerospace-specific rigid-body state names

The 3DOF and 6DOF blocks have been updated with state attribute tabs that enable you to:

- Assign unique names to single or multiple states with a comma-delimited list.
- Use state names instead of block paths throughout the linearization process.

Affected blocks are:

- 3DOF (Body Axes)
- 3DOF (Wind Axes)
- Custom Variable Mass 3DOF (Body Axes)
- Custom Variable Mass 3DOF (Wind Axes)
- Simple Variable Mass 3DOF (Body Axes)
- Simple Variable Mass 3DOF (Wind Axes)
- 6DOF (Quaternion)
- 6DOF ECEF (Quaternion)
- 6DOF Wind (Quaternion)

- 6DOF Wind (Wind Angles)
- Custom Variable Mass 6DOF (Quaternion)
- Custom Variable Mass 6DOF Wind (Quaternion)
- Custom Variable Mass 6DOF Wind (Wind Angles)
- Simple Variable Mass 6DOF (Euler Angles)
- Simple Variable Mass 6DOF (Quaternion)
- Simple Variable Mass 6DOF ECEF (Quaternion)
- Simple Variable Mass 6DOF Wind (Quaternion)
- Simple Variable Mass 6DOF Wind (Wind Angles)

Simulation Pace block works with Simulink simulation pacing

You can now configure the Simulation Pace block to work with Simulink simulation pacing using the **Sleep mode > Auto** option.

FlightGear Interface: Includes support for Version 2018.1 through flight simulator blocks

The Aerospace Blockset product now supports FlightGear v2018.1.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

R2018a

Version: 3.21

New Features

Bug Fixes

Compatibility Considerations

FlightGear Interface: Includes support for Version 2017.3 through flight simulator blocks

The Aerospace Blockset product now supports FlightGear v2017.3.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

Wrap states integration for angles in equation of motion blocks

To prevent angular output windup, these equation of motion blocks now wrap angles between $\pm\pi$ for roll, pitch, yaw, bank, flight path, heading, sideslip, and alpha:

- 3DOF (Body Axes)
- 3DOF (Wind Axes)
- Custom Variable Mass 3DOF (Body Axes)
- Custom Variable Mass 3DOF (Wind Axes)
- Simple Variable Mass 3DOF (Body Axes)
- Simple Variable Mass 3DOF (Wind Axes)
- 6DOF (Euler Angles)
- 6DOF Wind (Wind Angles)
- Custom Variable Mass 6DOF (Euler Angles)
- Custom Variable Mass 6DOF Wind (Wind Angles)
- Simple Variable Mass 6DOF (Euler Angles)
- Simple Variable Mass 6DOF Wind (Wind Angles)

Tunable Parameters

These block parameters are now tunable:

Block	Parameters
Three-Axis Gyroscope	Damping ratio, Natural frequency, Noise power, Noise seeds
Three-Axis Accelerometer	Damping ratio, Natural frequency, Noise power, Noise seeds
Three-Axis Inertial Measurement Unit	Accelerometer damping ratio, Gyro damping ratio, Natural frequency, Noise power
Von Karman Wind Turbulence Model (Continuous)	Noise seeds
Dryden Wind Turbulence Model (Continuous)	Noise seeds

Block	Parameters
Tustin Pilot Model	Pilot gain, Pilot time delay, Pilot lead constant
Crossover Pilot Model	Pilot Time delay, Pilot lead constant, Pilot lag constant
Precision Pilot Model	Pilot gain, Pilot time delay, Equalizer lead constant, Equalizer lag constant, Lag constant for neuromuscular system, Undamped natural frequency neuromuscular system, Damping neuromuscular system, Controlled element undamped natural frequency

These block parameters are now tunable while the model is in fast restart:

Blocks	Parameters
Rotation Angles to Rodrigues	Rotation order
Delta UT1	IERS data file, IERS URL data URL, Destination folder
WGS84 Gravity Model	Exclude Earth's atmosphere, Precessing reference frame, Day, Year, No centrifugal effects, Action for out-of-range input
Quaternion Interpolation	Methods, Action for out-of-range input
Rodrigues to Rotation Angles	Rotation order
Horizontal Wind Model 07	Action for out-of-range input
Horizontal Wind Model 14	Action for out-of-range input

Compatibility Considerations

If you have existing models from releases prior to R2018a that contain Three-Axis Gyroscope, Three-Axis Accelerometer, or Three-Axis Inertial Measurement Unit blocks, the software automatically updates the blocks in those models when you open them in R2018a or later. If you previously solved for steady state conditions for those models, solve for these steady state conditions again after opening in R2018a.

If you open this updated model in a release prior to R2018a, you must again solve for steady state conditions for the model in that release.

You can also use the Aerospace Blockset check in the Simulink Upgrade Advisor to identify the models that contain these blocks and that may require you to replace steady state computations. For more information, see [Check model for Aerospace Blockset navigation blocks \(Simulink\)](#).

Direction cosine matrix validity checks

These direction cosine matrix conversion blocks now verify the validity of the direction cosine matrix prior to conversion:

- Direction Cosine Matrix to Rotation Angles
- Direction Cosine Matrix ECEF to NED to Latitude and Longitude
- Direction Cosine Matrix to Quaternions
- Direction Cosine Matrix to Rodrigues
- Direction Cosine Matrix Body to Wind to Alpha and Beta

Each block now lets you specify the error tolerance level for the direction cosine matrix validation and specify an action if the matrix is not valid

Install FlightGear scenery during simulation

When you install the FlightGear software, the installation provides a basic level of scenery files. The FlightGear documentation guides you through installing scenery as part the general FlightGear installation. If you do not download scenery, you can direct FlightGear to download it automatically during simulation by selecting the Generate Run Script block **Install FlightGear scenery during simulation (requires Internet connection)** check box.

Disable FlightGear shaders

Your computer built-in video card, such as NVIDIA® cards, can conflict with FlightGear shaders. You can now disable the FlightGear shaders by selecting the Generate Run Script block **Disable FlightGear shader options** check box.

New Aerospace Blockset templates

The Simulink Start Page provides these new templates. Click the **Create Model** button to create templates that you can customize.

- 3DOF Longitudinal Airframe — Uses a three degree-of-freedom longitudinal airframe configured for linearization and handling quality analysis using the Simulink Control Design product. The Sky Hogg airframe parameters are used to initialize this template.
- Flight Instruments — Creates a model that has existing connections to Flight Instrument blocks.

R2017b

Version: 3.20

New Features

Bug Fixes

Difference Between UT1 and UTC: Calculate time difference with Delta UT1 block according to the IAU2000A reference system

Use the Delta UT1 block to calculate difference between principal Universal Time (UT1) and Coordinated Universal Time (UTC) according to the IAU2000A reference system.

FlightGear Interface: Includes support for Version 2017.1 through flight simulator blocks

The Aerospace Blockset product now supports FlightGear v2017.1.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see [Work with the Flight Simulator Interface](#).

WGS84 Gravity Model block updates

You can now input an M -by-3 array of latitudes, longitudes, and altitudes to the WGS84 Gravity Model block. In previous releases, you could input only a three-element vector of these values.

Quaternions to Rotation Angles, Rodrigues to Rotation Angles, and Direction Cosine Matrix to Rotation Angles updates

The Quaternions to Rotation Angles and Rodrigues to Rotation Angles blocks now return values for the middle angle of the 'ZYZ', 'ZXZ', 'YXY', 'YZY', 'YXY', and 'XZX' implementations. In previous releases, these blocks returned all zeroes for 0 degrees in the second rotation.

Related to these changes, the Direction Cosine Matrix to Rotation Angles block no longer has the **Limitation** parameter.

R2017a

Version: 3.19

New Features

Bug Fixes

Euler-Rodrigues Blocks: Convert to and from Rodrigues vectors

These blocks convert Euler-Rodrigues vectors to and from direction cosine matrices, rotation angles, and quaternions:

- Direction Cosine Matrix to Rodrigues
- Quaternions to Rodrigues
- Rodrigues to Direction Cosine Matrix
- Rodrigues to Quaternions
- Rodrigues to Rotation Angles
- Rotation Angles to Rodrigues

FlightGear Interface: Includes support for Version 2016.3 through flight simulator blocks

The Aerospace Blockset product now supports FlightGear v2016.3.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see [Work with the Flight Simulator Interface](#).

3DOF and 6DOF blocks now calculate inertial body accelerations

These 3DOF and 6DOF blocks now calculate inertial body accelerations:

- 3DOF blocks
 - 3DOF (Body Axes)
 - Simple Variable Mass 3DOF (Body Axes)
 - Custom Variable Mass 3DOF (Body Axes)
 - 3DOF (Wind Axes)
 - Simple Variable Mass 3DOF (Wind Axes)
 - Custom Variable Mass 3DOF (Wind Axes)
- 6DOF blocks
 - 6DOF (Euler Angles)
 - 6DoF (Quaternion)
 - 6DoF ECEF (Quaternion)
 - 6DoF Wind (Quaternion)
 - 6DoF Wind (Wind Angles)
 - Custom Variable Mass 6DoF (Euler Angles)

-
- Custom Variable Mass 6DoF (Quaternion)
 - Custom Variable Mass 6DoF ECEF (Quaternion)
 - Custom Variable Mass 6DoF Wind (Quaternion)
 - Custom Variable Mass 6DoF Wind (Wind Angles)
 - Simple Variable Mass 6DoF (Euler Angles)
 - Simple Variable Mass 6DoF (Quaternion)
 - Simple Variable Mass 6DoF ECEF (Quaternion)
 - Simple Variable Mass 6DoF Wind (Quaternion)
 - Simple Variable Mass 6DoF Wind (Wind Angles)

Aerospace Blockset Software and MATLAB string

The Aerospace Blockset software now supports MATLAB string.

R2016b

Version: 3.18

New Features

Bug Fixes

Horizontal Wind Model 14 Block: Calculate meridional and zonal wind components using U.S. Naval Research Laboratory HWM14 model

The Horizontal Wind Model 14 block implements the U.S. Naval Research Laboratory HWM™ routine to calculate the meridional and zonal components of the wind for a set of geophysical data.

Dryden MIL-HDBK-1797B Turbulence Models: Calculate turbulence velocities and angular rates using MIL-HDBK-1797B mathematical representation

The Dryden Wind Turbulence Model (Continuous) and Dryden Wind Turbulence Model (Discrete) blocks now also implement the mathematical representation in the Military Handbook MIL-HDBK-1797B.

FlightGear Version 2016.1 Support: Interface with FlightGear through flight simulator blocks

The Aerospace Blockset product now supports FlightGear v2016.1.

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see Flight Simulator Interface.

Simulink units and Aerospace Blockset units

Block units and unit conversion blocks in the Aerospace Blockset software now support Simulink units.

Property Inspector available for Aerospace Blockset blocks

Property Inspector view is now available for Aerospace Blockset. For more information on the Property Inspector, see Setting Properties and Parameters.

R2016a

Version: 3.17

New Features

Bug Fixes

Compatibility Considerations

Flight Instruments: Display measurements through standard cockpit instruments

Use these blocks, representing standard cockpit instruments, to display measurements:

- Airspeed Indicator
- Altimeter
- Artificial Horizon
- Climb Rate Indicator
- Exhaust Gas Temperature (EGT) Indicator
- Heading Indicator
- Revolutions Per Minute (RPM) Indicator
- Turn Coordinator

For more information, see Flight Instrument Gauges.

Quaternion Interpolation: Calculate interpolation between two quaternions

The Quaternion Interpolation block interpolates between two quaternions.

Simulink Units

Units and unit conversion blocks in the Aerospace Blockset software are independent of Simulink units. All blocks from Aerospace Blockset software are treated as computation blocks, and do not propagate units across them.

Updated Examples

These examples have been updated to use the From Spreadsheet block to read data saved in a spreadsheet from a previous simulation:

- HL-20 with Optional FlightGear Interface
- Quadcopter Project

These examples have been updated to use the flight instruments blocks:

- HL-20 Lifting Body and Controller with Flight Instrumentation Blocks
- HL-20 Lifting Body and Controller with Simulink 3D Animation and Flight Instrumentation Blocks

FlightGear versions earlier than 2.0 no longer supported

The Aerospace Blockset software no longer supports FlightGear versions earlier than 2.0. For a list of FlightGear versions that the Aerospace Blockset software supports, see Supported FlightGear Versions.

Compatibility Considerations

If you are using a FlightGear version older than 2.0, update your FlightGear installation to a supported version. When you open the model, the software receives a warning or error. Obtain updated FlightGear software from www.flightgear.org in the download area.

Unit conversion block precision changes

These unit conversion blocks may now generate values with better precision:

- Acceleration Conversion
- Angle Conversion
- Angular Acceleration Conversion
- Angular Velocity Conversion
- Density Conversion
- Force Conversion
- Length Conversion
- Mass Conversion
- Pressure Conversion
- Temperature Conversion
- Velocity Conversion

R2015aSP1

Version: 3.15.1

Bug Fixes

R2015b

Version: 3.16

New Features

Bug Fixes

FlightGear Versions 3.2 and 3.4 Support: Interface to these FlightGear versions through flight simulator blocks

These blocks support FlightGear v3.2 and v3.4:

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see Flight Simulator Interface.

International Geomagnetic Reference Field 12 Block: Calculate Earth magnetic field and secular variation

The International Geomagnetic Reference Field 12 block calculates Earth magnetic field and secular variation using 12th generation of International Geomagnetic Reference Field. It replaces the International Geomagnetic Reference Field 11 block.

Tunable Parameters

These block parameters are now tunable:

Block	Parameters
3DOF (Body Axes) block	Inertia
	Initial incidence
	Initial velocity
	Empty mass
	Full mass
3DOF (Wind Axes) block	Inertia body axes
	Initial airspeed
	Empty mass
	Full mass
4th Order Point Mass (Longitudinal)	Initial airspeed
6DOF (Euler Angles)	Inertia
	Initial velocity in body axes [Xe,Ye,Ze]
	Empty mass
	Full mass
6DOF ECEF blocks	Initial position in geodetic latitude, longitude and altitude
	Inertia
	Initial velocity in body axis

Block	Parameters
	Empty mass
	Full mass
	Rotational rate
6DOF Wind blocks	Inertia
	Initial airspeed, angle of attack, and sideslip
	Empty mass
	Full mass
6th Order Point Mass (Coordinated Flight)	Initial airspeed
Aerodynamic Forces and Moments block	Reference span
	Reference length
Discrete Wind Gust Model block	Gust length [dx dy dz]
Estimate Center of Gravity block	Empty mass
	Full mass
Self Conditioned [A,B,C,D] block	Poles of A-H*C
Three-Axis Accelerometer block	Lower and upper output limits
Three-Axis Gyroscope block	Lower and upper output limits

Updated examples

- The HL-20 with Optional FlightGear Interface example has been updated to:
 - Help you get started using FlightGear for the example.
 - Provide an example of a fault tolerant controller implemented with Stateflow® software. If you do not have Stateflow software installed or do not want to use the reactive controller, click the **No Logic** button in the Redundant controller settings block.
- The Quadcopter Project example has been updated with a trajectory generator.

R2015a

Version: 3.15

New Features

Bug Fixes

Earth-centered inertial to azimuth, elevation, and range block

The ECI Position to AER block calculates azimuth, elevation, and slant range coordinates for Earth-centered inertial position.

Additional ephemerides coefficient support for celestial phenomena blocks

The Planetary Ephemeris and Moon Libration blocks now support the DE432t ephemerides database.

New World Magnetic Model 2015 block

The World Magnetic Model 2015 block implements the world magnetic model for years 2015 to 2020 (WMM-2015).

Updated Example

The HL-20 with Optional FlightGear Interface example has been updated to take advantage of Simulink Projects.

R2014b

Version: 3.14

New Features

Bug Fixes

Compatibility Considerations

Horizontal Wind Model 07 block

The Horizontal Wind Model 07 block implements the U.S. Naval Research Laboratory HWM routine to calculate the meridional and zonal components of the wind for a set of geophysical data.

Flight simulator interface block support for FlightGear Version 3

These blocks support FlightGear v3.0:

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see Flight Simulator Interface.

Additional ephemerides coefficient support for celestial phenomena blocks

The Planetary Ephemeris, Earth Nutation, and Moon Libration blocks now support the DE430 ephemerides database.

Examples

- Quadcopter Project — New example that shows how to use Simulink Projects and Aerospace Blockset blocks to model a quadcopter. It uses the Flight Simulation Example Simulink project template to manage the model and source files. For more information on this template, see Simulink Projects Template for Flight Simulation Applications.
- HL-20 with Optional FlightGear Interface — Existing example updated with a Run FlightGear block to help you get started using FlightGear for the example.

Receive net_ctrl Packet from FlightGear data storage change

The Receive net_ctrl Packet from FlightGear block no longer stores the UdpRecvPkt signal at simulation when you select the **Data Import/Export > States** or **Final states** check box. In previous releases, the block stored this signal.

Equations of motion 3DOF and 6DOF acceleration values

The equations of motion 3DOF and 6DOF blocks now include the gravity and rotating frame terms when calculating the accelerations of the body with respect to the inertial frame. As a result, you may notice different acceleration values.

Compatibility Considerations

If your model has 3DoF and 6DoF blocks from library versions prior to 3.13 (R2014a), you can use the Aerospace Blockset check in the Simulink Upgrade Advisor to identify the blocks in your model to replace. For more information, see [Check model for legacy 3DoF or 6DoF blocks](#).

R2014a

Version: 3.13

New Features

Bug Fixes

Blocks to convert between latitude, longitude, altitude and Earth-centered inertial coordinates

The LLA to ECI Position block in the Utilities/Axes Transformations sublibrary converts geodetic latitude, longitude, altitude (LLA) coordinates to Earth-centered inertial (ECI) position coordinates, based on the specified reduction method and Coordinated Universal Time (UTC), for the specified time and geophysical data.

The ECI Position to LLA block converts Earth-centered inertial (ECI) position coordinates to geodetic latitude, longitude, altitude (LLA) coordinates, based on the specified reduction method and Coordinated Universal Time (UTC), for the specified time and geophysical data.

Flight simulator interface block support for FlightGear Version 2.12

These blocks support FlightGear v2.12:

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see Flight Simulator Interfaces.

Equations of Motion 3DOF and 6DOF handle large mass changes

- The following 3DOF and 6DOF blocks have been extended to handle large mass changes over time:
 - Custom Variable Mass 3DOF (Body Axes)
 - Custom Variable Mass 3DOF (Wind Axes)
 - Simple Variable Mass 3DOF (Body Axes)
 - Simple Variable Mass 3DOF (Wind Axes)
 - Custom Variable Mass 6DOF (Euler Angles)
 - Custom Variable Mass 6DOF (Quaternion)
 - Custom Variable Mass 6DOF ECEF (Quaternion)
 - Custom Variable Mass 6DOF Wind (Quaternion)
 - Custom Variable Mass 6DOF Wind (Wind Angles)
 - Simple Variable Mass 6DOF (Euler Angles)
 - Simple Variable Mass 6DOF (Quaternion)
 - Simple Variable Mass 6DOF ECEF (Quaternion)
 - Simple Variable Mass 6DOF Wind (Quaternion)
 - Simple Variable Mass 6DOF Wind (Wind Angles)

For more information, see “Blocks being removed or changed” on page 19-3.

- The Equations of Motion 3DoF and 6DoF libraries have been renamed to 3DOF and 6DOF.
- The names of all blocks in the Equations of Motion/6DOF and 3DOF libraries have changed to contain DOF instead of DoF.

Blocks being removed or changed

Block or Block Element Name	What Happens When You Use the Block or Element?	Use This Block or Block Element Instead
3DoF (Body Axes)	Still works. Help button redirects to 3DOF (Body Axes) block.	3DOF (Body Axes)
3DoF (Wind Axes)	Still works. Help button redirects to 3DOF (Wind Axes) block.	3DOF (Wind Axes)
Custom Variable Mass 3DoF (Body Axes)	Still works. Help button redirects to Custom Variable Mass 3DOF (Body Axes) block.	Custom Variable Mass 3DOF (Body Axes)
Custom Variable Mass 3DoF (Wind Axes)	Still works. Help button redirects to Custom Variable Mass 3DOF (Wind Axes) block.	Custom Variable Mass 3DOF (Wind Axes)
Simple Variable Mass 3DoF (Body Axes)	Still works. Help button redirects to Simple Variable Mass 3DOF (Body Axes) block.	Simple Variable Mass 3DOF (Body Axes)
Simple Variable Mass 3DoF (Wind Axes)	Still works. Help button redirects to Simple Variable Mass 3DOF (Wind Axes) block.	Simple Variable Mass 3DOF (Wind Axes)
6DoF (Euler Angles)	Still works. Help button redirects to 6DOF (Euler Angles) block.	6DOF (Euler Angles)
6DoF (Quaternion)	Still works. Help button redirects to 6DOF (Quaternion) block.	6DOF (Quaternion)
6DoF Wind (Wind Angles)	Still works. Help button redirects to 6DOF Wind (Wind Angles) block.	6DOF Wind (Wind Angles)
6DoF Wind (Quaternion)	Still works. Help button redirects to 6DOF Wind (Quaternion) block.	6DOF Wind (Quaternion)
6DoF ECEF (Quaternion)	Still works. Help button redirects to 6DOF ECEF (Quaternion) block.	6DOF ECEF (Quaternion)
Custom Variable Mass 6DoF (Euler Angles)	Still works. Help button redirects to Custom Variable Mass 6DOF (Euler Angles) block.	Custom Variable Mass 6DOF (Euler Angles)
Custom Variable Mass 6DoF (Quaternion)	Still works. Help button redirects to Custom Variable Mass 6DOF (Quaternion) block.	Custom Variable Mass 6DOF (Quaternion)
Custom Variable Mass 6DoF ECEF (Quaternion)	Still works. Help button redirects to Custom Variable Mass 6DOF ECEF (Quaternion) block.	Custom Variable Mass 6DOF ECEF (Quaternion)

Block or Block Element Name	What Happens When You Use the Block or Element?	Use This Block or Block Element Instead
Custom Variable Mass 6DoF Wind (Quaternion)	Still works. Help button redirects to Custom Variable Mass 6DOF Wind (Quaternion) block.	Custom Variable Mass 6DOF Wind (Quaternion)
Custom Variable Mass 6DoF Wind (Wind Angles)	Still works. Help button redirects to Custom Variable Mass 6DOF Wind (Wind Angles) block.	Custom Variable Mass 6DOF Wind (Wind Angles)
Simple Variable Mass 6DoF (Euler Angles)	Still works. Help button redirects to Simple Variable Mass 6DOF (Euler Angles) block.	Simple Variable Mass 6DOF (Euler Angles)
Simple Variable Mass 6DoF (Quaternion)	Still works. Help button redirects to Simple Variable Mass 6DOF (Quaternion) block.	Simple Variable Mass 6DOF (Quaternion)
Simple Variable Mass 6DoF ECEF (Quaternion)	Still works. Help button redirects to Simple Variable Mass 6DOF ECEF (Quaternion) block.	Simple Variable Mass 6DOF ECEF (Quaternion)
Simple Variable Mass 6DoF Wind (Quaternion)	Still works. Help button redirects to Simple Variable Mass 6DOF Wind (Quaternion) block.	Simple Variable Mass 6DOF Wind (Quaternion)
Simple Variable Mass 6DoF Wind (Wind Angles)	Still works. Help button redirects to Simple Variable Mass 6DOF Wind (Wind Angles) block.	Simple Variable Mass 6DOF Wind (Wind Angles)

Add ephemeris and geoid data

Use the **Get data** button to add ephemeris and/or geoid data for the following Aerospace Blockset blocks:

- Geoid Height

Note This works only for the EGM2008 Geopotential Model. The software provides EGM96 Geopotential Model data.

- Earth Nutation
- Moon Libration
- Planetary Ephemeris

New example Simulink project template

A new example Simulink project template is available to help you create a flight simulation application project. To open this template, in MATLAB, select **New > Simulink Project > Flight Simulation Example**. Follow the directions in the template. For more information, see Simulink Projects Template for Flight Simulation Applications.

R2013b

Version: 3.12

New Features

Bug Fixes

Compatibility Considerations

Flight simulator interface block support for FlightGear Version 2.10

These blocks support FlightGear v2.10:

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see Flight Simulator Interface.

Direction Cosine Matrix ECI to ECEF block to convert Earth-Centered Inertial to Earth-Centered Earth-Fixed coordinates

The Direction Cosine Matrix ECI to ECEF block in the Utilities/Axes Transformations sublibrary calculates the position direction cosine matrix (ECI to ECEF), based on the specified reduction method and Coordinated Universal Time (UTC), for the specified time and geophysical data.

Julian Date Conversion block to convert specified calendar date to Julian date or modified Julian date

The Julian Date Conversion block in the Utilities/Unit Conversions sublibrary converts the specified date to the Julian date or modified Julian date.

Latitude inputs outside +90 and -90 degrees

These blocks now correctly take into account latitude inputs that are outside +90 and -90 degrees.

- NRLMSISE-00 Atmosphere Model
- Geoid Height
- WGS84 Gravity Model
- Geodetic to Geocentric Latitude
- Geocentric to Geodetic Latitude
- LLA to ECEF Position

Phaseout of FlightGear versions earlier than 2.0

The Aerospace Blockset software will not support FlightGear versions earlier than 2.0 in a future release of Aerospace Blockset. For a list of FlightGear versions that the Aerospace Blockset software supports, see Supported FlightGear Versions.

Compatibility Considerations

If you are using a FlightGear version older than 2.0, update your FlightGear installation to a supported version.

You can use the Aerospace Blockset check in the Simulink Upgrade Advisor to identify the blocks in your model that refer to FlightGear versions that the software no longer supports, or will no longer support. For more information, see [Check model and local libraries for legacy Aerospace Blockset blocks](#).

R2013a

Version: 3.11

New Features

Bug Fixes

Flight simulator interface block support for FlightGear Version 2.8

These blocks support FlightGear v2.8.0:

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

For more information on working with FlightGear, see Flight Simulator Interface.

Planetary Ephemeris block to implement position and velocity of Solar System planets

The Planetary Ephemeris block in the Environment/Celestial Phenomena sublibrary implements the position and velocity of an astronomical object.

Earth Nutation block to implement nutation in longitude and obliquity of Earth

The Earth Nutation block in the Environment/Celestial Phenomena sublibrary implements the nutation in longitude and obliquity of Earth according to the International Astronomical Union (IAU) 1980 nutation series.

Moon Libration block to implement relative motion attitude of Moon

The Moon Libration block in the Environment/Celestial Phenomena sublibrary implements the relative motion attitude of Earth's Moon.

Lowest altitude parameter for specifying altitudes below sea level using Lapse Rate Model block

The **Lowest altitude (m)** parameter of the Lapse Rate Model block enables to specify an altitude below sea level to calculate varying values of temperature and pressure below mean sea level. For more information, see Lapse Rate Model.

Updated Demo

The NASA HL-20 with FlightGear Interface example has been updated. You no longer need FlightGear software installed to simulate the example. Instead, you can choose an alternate data input source from the Variant block. For more information, see NASA HL-20 with FlightGear Interface.

R2012b

Version: 3.10

New Features

Bug Fixes

Flight simulator interface block support for FlightGear versions 2.4 and 2.6

These blocks have been updated to support FlightGear Versions 2.4 and 2.6:

- FlightGear Preconfigured 6DoF Animation
- Generate Run Script
- Pack net_fdm Packet for FlightGear
- Receive net_ctrl Packet from FlightGear
- Unpack net_ctrl Packet from FlightGear

The Aerospace Blockset product now supports FlightGear Versions 2.6 and 2.4.

For more information on working with FlightGear, see [Flight Simulator Interface](#).

Crossover Pilot Model, Precision Pilot Model, and Tustin Pilot Model blocks for modeling human pilots

The new Pilot library contains blocks that represent a human pilot:

- Tustin Pilot Model
- Crossover Pilot Model
- Precision Pilot Model

R2012a

Version: 3.9

New Features

Compatibility Considerations

Updated Actuator Blocks

The actuator blocks have improved dynamic behavior and give you more control over initial conditions. For more information, see “Blocks and Block Elements Being Removed” on page 23-2.

Support for Bidirectional Communication Between FlightGear and Simulink

Using UDP packets, the Aerospace Blockset software can now send and receive data between a Simulink model and a running FlightGear Flight Simulator. The Aerospace Blockset software has been updated with new and updated blocks.

- New blocks:
 - Receive net_ctrl Packet from FlightGear — Receives a network control and environment data packet net_ctrl from the simulation of a Simulink model in the FlightGear simulator.
 - Unpack net_ctrl Packet from FlightGear — Unpacks net_ctrl variable packets received from FlightGear and makes them available for the Simulink environment.
- Updated block Generate Run Script, with the following new parameters:
 - **Select target architecture**
 - **FlightGear data flow**
 - **Origin address**
 - **Origin port**

Blocks and Block Elements Being Removed

Block or Block Element Name	What Happens When You Use the Block or Element?	Use This Block or Block Element Instead
Second Order Linear Actuator	Still works. Help button redirects to Linear Second-Order Actuator block.	Linear Second-Order Actuator
Second Order Nonlinear Actuator	Still works. Help button redirects to Nonlinear Second-Order Actuator block.	Nonlinear Second-Order Actuator

Updated Example

The NASA HL-20 with FlightGear Interface has been updated to show how you can receive FlightGear Flight Simulator data into a Simulink model.

Using FlightGear Version 2.4.0 with Aerospace Blockset Software

Version 3.9 of Aerospace Blockset software does not support FlightGear Version 2.4.0. You can use this procedure to modify your FlightGear installation to use FlightGear Version 2.4.0:

- 1 In the Simulink model, if it contains these blocks, double-click them: FlightGear Preconfigured 6DoF Animation, Pack net_fdm Packet for FlightGear, Receive net_ctrl Packet from FlightGear, Unpack net_ctrl Packet from FlightGear.

The block parameter dialog box opens.

- 2 In the **FlightGear version** parameter, select v2.0.
- 3 In the Simulink model, double-click the Generate Run Script block.
- 4 In the **FlightGear base directory** parameter, set the FlightGear base folder to the location of FlightGear Version 2.4.0.
- 5 Click the **Generate Script** button.

The block creates a custom FlightGear run script.

- 6 If you use the Receive net_ctrl Packet from FlightGear, or Unpack net_ctrl Packet from FlightGear, open the custom FlightGear run script with a text editor and change the input parameter ' - - fdm ' parameter. In the run script, look for the following string:

```
--fdm=network,localhost,5501,5502,5503
```

Change this string:

```
--fdm=null --native-fdm=socket,in,30,127.0.0.1,5502,udp
```

- 7 Save and close this file.

For more information on working with FlightGear, see *Introducing the Flight Simulator Interface in the Aerospace Blockset User's Guide*.

R2011b

Version: 3.8

New Features

Compatibility Considerations

Conversion of Error and Warning Message Identifiers

For R2011b, error and warning message identifiers have changed in Aerospace Blockset.

Compatibility Considerations

If you have scripts or functions that use message identifiers that changed, you must update the code to use the new identifiers. Typically, message identifiers are used to turn off specific warning messages.

For example, the `aeroblk:sltranslate` identifier has changed to `aeroblks:sltranslate:invalidVersion`. If your code checks for `aeroblk:sltranslate`, you must update it to check for `aeroblks:sltranslate:invalidVersion` instead.

To determine the identifier for a warning, run the following command just after you see the warning:

```
[MSG,MSGID] = lastwarn;
```

This command saves the message identifier to the variable `MSGID`.

Note Warning messages indicate a potential issue with your code. While you can turn off a warning, a suggested alternative is to change your code so it runs warning-free.

Efficient C Code Generation

With the code reuse functionality from Simulink Coder™, the Aerospace Blockset software now has efficient C code generation for all blocks. In previous releases, you could not reuse generated code.

Blocks and Block Elements Being Removed

Blocks or Block Element Names	What Happens When You Use the Block or Element?	Use These Blocks or Block Element Names Instead	Compatibility Considerations
World Magnetic Model 2000	Nothing.	For model years between 2000 and the start of 2010, use International Geomagnetic Reference Field 11. For model years between 2010 and the start of 2015, use World Magnetic Model 2010.	For model years between 2000 and the start of 2010, use International Geomagnetic Reference Field 11. For model years between 2010 and the start of 2015, use World Magnetic Model 2010.

Blocks or Block Element Names	What Happens When You Use the Block or Element?	Use These Blocks or Block Element Names Instead	Compatibility Considerations
World Magnetic Model 2005	Nothing.	For model years between 2000 and the start of 2010, use International Geomagnetic Reference Field 11. For model years between 2010 and the start of 2015, use World Magnetic Model 2010.	For model years between 2000 and the start of 2010, use International Geomagnetic Reference Field 11. For model years between 2010 and the start of 2015, use World Magnetic Model 2010.

R2011a

Version: 3.7

New Features

Compatibility Considerations

New LLA to Flat Earth Block

The LLA to Flat Earth block estimates the flat Earth position from geodetic latitude, longitude, and altitude.

New International Geomagnetic Reference Field 11 Block

The International Geomagnetic Reference Field 11 block calculates the Earth's magnetic field and secular variation using the eleventh generation of the International Geomagnetic Reference Field.

Spherical Harmonic Gravity Model Supports New Planet Model

The Spherical Harmonic Gravity Model block now supports the EIGEN-GL04C gravity field model.

Simulink Coder Inlined Code Generation

The following blocks now generate inlined code for all targets:

- COESA Atmosphere Model
- Pressure Altitude
- Non-Standard Day 210C
- Non-Standard Day 310
- NRLMSISE-00 Atmosphere Model
- WGS84 Gravity Model
- Spherical Harmonic Gravity Model

In previous releases, if your model contained these blocks, you needed to perform the following to generate code:

- In the Simulink Configurations Parameters pane, select the **Support: non-inlined S-functions** check box on the **Code Generation > Interface** pane.
- Include other source files to generate code.

Compatibility Considerations

You can now generate code directly from models that contain these blocks. To use existing models:

- In the Simulink Configurations Parameters pane, clear the **Support: non-inlined S-functions** check box on the **Code Generation > Interface** pane.
- Do not include the other source files you previously included to generate code for your model.

Aerospace Blockset Product Now in Simulink Start, Help, and Demos Category

The Simulink category now contains the Aerospace Blockset software product.

Compatibility Considerations

This change impacts you in the following ways:

- Finding and viewing this product through the MATLAB Desktop **Start** button and in the Help browser **Contents** and **Demos** panes.
- Using the `demo` command to access the product demos.

R2010b

Version: 3.6

New Features

Compatibility Considerations

New Geoid Height Block

The Geoid Height block calculates the height of geoid undulations using one of three geopotential models.

FlightGear Version 2.0 with Aerospace Blockset Software

The Aerospace Blockset product now supports FlightGear Version 2.0.

For more information on working with FlightGear, see *Introducing the Flight Simulator Interface in the Aerospace Blockset User's Guide*.

Blocks and Block Elements Being Removed

Block or Block Element Name	What Happens When You use the Block or Element?	Use This Instead	Compatibility Considerations
EGM96 Geoid	Still works. Help button redirects to Geoid Height block.	Geoid Height	Replace all existing instances of EGM96 Geoid with Geoid Height.
SinCos	Get Simulink Trigonometric Function block behavior. Help button redirects to Trigonometric Function block.	Trigonometric Function	Replace all existing instances of SinCos with Trigonometric Function.

R2010a

Version: 3.5

New Features

Bug Fixes

New Centrifugal Effect Model Block

The Centrifugal Effect Model block implements the gravity centrifugal effect for eight planets and the Moon, plus the capability to customize this effect.

New Spherical Harmonic Gravity Model Block

The Spherical Harmonic Gravity Model block implements the spherical harmonic gravity models for Earth (EGM2008, EGM96), Moon (LP100K, LP165P), and Mars (GMM2B), plus the capability to customize these models.

New World Magnetic Model 2010 Block

The World Magnetic Model 2010 block implements the world magnetic model for years 2010-2015 (WMM-2010).

Demo

The following demo is new:

Gravity Models with Precessing Reference Frame — Illustrates various gravity models with precessing reference frames implemented with the Aerospace Blockset blocks.

Support for the Simulink For Each Subsystem Block

The Aerospace Blockset product now supports the Simulink For Each Subsystem within the limitations of that subsystem.

R2009b

Version: 3.4

New Features

Bug Fixes

New Zonal Harmonic Gravity Model Block

The Zonal Harmonic Gravity Model block implements the zonal harmonic gravity model.

FlightGear Version 1.9.1 with Aerospace Blockset Software

Aerospace Blockset Version 3.4 now supports FlightGear Version 1.9.1.

For more information on working with FlightGear, see *Introducing the Flight Simulator Interface in the Aerospace Blockset User's Guide*.

Using the Send net_fdm Packet to FlightGear Block to Communicate with Simulink Real-Time Applications

The Send net_fdm Packet to FlightGear block now supports Simulink Real-Time™ applications.

In previous releases, you could not use the Send net_fdm Packet to FlightGear block to communicate with Simulink Real-Time applications. Instead, you had to replace the Aerospace Blockset Send net_fdm Packet to FlightGear with the Simulink Real-Time UDP Send block.

R2009a

Version: 3.3

New Features

Bug Fixes

Enhanced Invert 3x3 Matrix Block Inverse Calculation

The Invert 3x3 Matrix block no longer uses the determinant and adjoint to calculate the inverse. It now uses the Product block.

Saving and Restoring the Complete SimState

Use the new SimState feature to save the complete simulation state. Unlike the final states stored in earlier versions of Simulink, the SimState contains the complete simulation state of the model (including block states that are logged). You can then restore the state at a later time and continue simulation from the exact instant at which you stopped the simulation. See Saving and Restoring the Simulation State as the SimState in the Simulink User's Guide.

Using FlightGear Version 1.9.0 with Aerospace Blockset Software

Version 3.3 of Aerospace Blockset software does not support FlightGear Version 1.9.0. You can use this procedure.

- 1 In the Simulink model, double-click the FlightGear Preconfigured 6DoF Animation block or the Pack net_fdm Packet for FlightGear block.

The block parameter dialog box is displayed.

- 2 In the **FlightGear version** parameter, select v1.0.
- 3 In the Simulink model, double-click the Generate Run Script block.

The block parameter dialog box is displayed.

- 4 In the **FlightGear base directory** parameter, set the FlightGear base folder to the location of FlightGear Version 1.9.0.
- 5 Click the **Generate Script** button.

The block creates a custom FlightGear run script.

- 6 Open the custom FlightGear run script with a text editor and change the input parameter ' --airport-id=' to ' --airport='.
- 7 Save and close this file.

For more information on working with FlightGear, see Introducing the Flight Simulator Interface in the Aerospace Blockset User's Guide.

R2008b

Version: 3.2

New Features

Bug Fixes

FlightGear Version 1.0 with Aerospace Blockset Software

Aerospace Blockset Version 3.2 now supports FlightGear Version 1.0. To access this version of FlightGear, you can use this procedure.

- 1 In the Simulink model, double-click the FlightGear Preconfigured 6DoF Animation block or the Pack net_fdm Packet for FlightGear block.

The block parameter dialog box appears.

- 2 In the **FlightGear version** parameter, select v1.0.
- 3 In the Simulink model, double-click the Generate Run Script block.

The block parameter dialog box appears.

- 4 In the **FlightGear base directory** parameter, set the FlightGear base folder to the location of FlightGear Version 1.0.

For more information on working with FlightGear, see *Introducing the Flight Simulator Interface in the Aerospace Blockset User's Guide*.

Updated Aerospace Blockset Blocks

The following blocks have been updated to support FlightGear Version 1.0:

- FlightGear Preconfigured 6DoF Animation
- Pack net_fdm Packet for FlightGear
- Send net_fdm Packet to FlightGear

R2008a

Version: 3.1

New Features

Bug Fixes

Quaternion Support for the Embedded MATLAB Function Block

You can now access the following quaternion functions through the Embedded MATLAB Function block:

- `quatconj`
- `quatinv`
- `quatmod`
- `quatmultiply`
- `quatdivide`
- `quatnorm`
- `quatnormalize`

New Aerospace Blockset Demos

The Aerospace Blockset product has the following new demos:

- `asbSkyHogg`, which illustrates the design of a lightweight airplane.
- `asbQuatEML`, which illustrates a quaternion and models the equations.

Using FlightGear Version 1.0 with Aerospace Blockset Software

Version 3.1 of Aerospace Blockset software does not support FlightGear Version 1.0. You can use this procedure.

- 1 In the Simulink model, double-click the FlightGear Preconfigured 6DoF Animation block or the Pack `net_fdm` Packet for FlightGear block.

The block parameter dialog box is displayed.

- 2 In the **FlightGear version** parameter, select `v0.9.10`.
- 3 In the Simulink model, double-click the Generate Run Script block.

The block parameter dialog box is displayed.

- 4 In the **FlightGear base directory** parameter, set the FlightGear base folder to the location of FlightGear Version 1.0.

For more information on working with FlightGear, see *Introducing the Flight Simulator Interface in the Aerospace Blockset User's Guide*.

R2007b

Version: 3.0

New Features

Bug Fixes

Compatibility Considerations

Direction Cosine Matrix to Rotation Angles Block Replaces Direction Cosine Matrix to Euler Angle Block

The Direction Cosine Matrix to Rotation Angles block converts spatial representation from direction cosine matrix to any of 12 standard sequences of rotation angles.

Compatibility Considerations

The Direction Cosine Matrix to Euler Angle block is deprecated. Models built with the old block continue to be supported from an obsolete library that ships with the Aerospace Blockset product but is not visible in the Library Browser.

Rotation Angles to Direction Cosine Matrix Block Replaces Euler Angle to Direction Cosine Block

The Rotation Angles to Direction Cosine Matrix block converts spatial representation from any of 12 standard sequences of rotation angles to direction cosine matrix.

Compatibility Considerations

The Euler Angle to Direction Cosine Matrix block is deprecated. Models built with the old block continue to be supported from an obsolete library that ships with the Aerospace Blockset product but is not visible in the Library Browser.

New CIRA-86 Atmosphere Model Block

The CIRA-86 Atmosphere Model block implements the COSPAR International Reference Atmosphere (CIRA) 1986 environmental model.

New NRLMSISE-00 Atmosphere Model Block

The NRLMSISE-00 Atmosphere Model block implements the 2001 United States Naval Research Laboratory Mass Spectrometer and Incoherent Scatter Radar Exosphere (NRLMSISE) environmental model.

New EGM96 Geoid Block

The EGM96 Geoid block implements the 1996 Earth Geopotential Model (EGM96).

Quaternions to Rotation Angles Block Replaces Quaternions to Euler Angles Block

The Quaternions to Rotation Angles block converts spatial representation from quaternions to any of 12 standard sequences of rotation angles.

Compatibility Considerations

The Quaternions to Euler Angles block is deprecated. Models built with the old block continue to be supported from an obsolete library that ships with the Aerospace Blockset software but is not visible in the Library Browser.

Rotation Angles to Quaternions Block Replaces Euler Angles to Quaternions Block

The Rotation Angles to Quaternions block converts spatial representation from any of 12 standard sequences of rotation angles to quaternions.

Compatibility Considerations

The Euler Angles to Quaternions block is deprecated. Models built with the old block continue to be supported from an obsolete library that ships with the Aerospace Blockset software but is not visible in the Library Browser.

Enhanced HL-20 Demo

The HL-20 demo (aeroblk_HL20) control system has been enhanced.

R2007a

Version: 2.3

New Features

Bug Fixes

Compatibility Considerations

New MATLAB Animation Block

The MATLAB Animation block creates a six-degrees-of-freedom animation of multiple bodies that have custom geometries. It is based on the `Aero.Animation` object.

New Pilot Joystick All Block

The Pilot Joystick All block provides a joystick interface on Windows platforms. This block is the same as Pilot Joystick, but its `Output` configuration parameter is set by default to `AllOutputs`. It outputs six analog channels, buttons, and point of view indicators.

WGS84 Gravity Model Block Modified

The first input of the WGS84 Gravity Model block is now a three-signal vector that contains the position in geodetic latitude, longitude, and altitude. The second optional input is now a scalar that contains the manually-specified Julian centuries. The WGS84 Gravity Model block also has new output coordinates and dimensions to output the gravity vector in NED coordinates.

Compatibility Considerations

The old WGS84 Gravity Model block is deprecated. Models built with the old block continue to be supported from an obsolete library that ships with the Aerospace Blockset product but is not visible in the Library Browser. To use the new version of the WGS84 Gravity Model block, you must replace the old WGS84 Gravity Model block from the Environment/Gravity library and reconnect the input to take into account the three-signal vector format.

New Aerospace Blockset Demo

The Aerospace Blockset product has a new demo, Multiple Unmanned Air Vehicles with Collaborative Control, which illustrates the use of the MATLAB Animation block.

R2006b

Version: 2.2

New Features

Bug Fixes

Aerospace Toolbox Product Replaces Control System Toolbox Product as Requirement for Aerospace Blockset Product

The new Aerospace Toolbox product is now required to use the Aerospace Blockset software.

The Control System Toolbox product is no longer required for the Aerospace Blockset product. It is recommended for certain applications and still required for certain blocks.

Interpolate Matrix Blocks Modified

The Interpolate Matrix(x), Interpolate Matrix(x,y), and Interpolate Matrix(x,y,z) blocks have been modified to accept the new Simulink Prelookup block output. The Interpolate Matrix blocks inputs have been doubled in number. You must now provide the interpolation index and interpolation fraction as separate input signals.

The old Interpolate Matrix and Prelookup blocks are deprecated. Models built with the old blocks continue to be supported from the Aerospace Blockset and Simulink obsolete libraries, but not visible in the Library Browser.

Aerodynamic Forces and Moments Block Extended

The Aerodynamic Forces and Moments block has been extended to allow calculations in the stability and wind axes, in addition to the body axes.

To preserve backward compatibility, the default state of the block assumes a body-body transformation and hides the body velocity input port. If you change this default to stability or wind axes, the body velocity port appears.

New Digital DATCOM Forces and Moments Block

The Digital DATCOM Forces and Moments block calculates aerodynamic forces and moments using the Digital DATCOM static and dynamic stability derivatives and coefficients.

FlightGear Version 0.9.10 Is Supported by FlightGear Simulator Interface

The FlightGear simulator interface now supports the standard binary distributions of FlightGear version 0.9.10 on all platforms.

The FlightGear Preconfigured 6DoF Animation and Pack net_fdm Packet for FlightGear blocks have been updated accordingly, as have the asbh120 and asbdhc2 demos.

Pack net_fdm Packet for FlightGear Now Supports Code Generation

With Real-Time Workshop®, the Pack net_fdm Packet for FlightGear block now generates code for all targets, including xPC Target.

The Send net_fdm Packet to FlightGear and FlightGear Preconfigured 6DoF Animation blocks now generate valid but nonfunctional code. For simulating with FlightGear on an Simulink Real-Time

computer, use the Pack net_fdm Packet for FlightGear block with the UDP Send block from the Simulink Real-Time block library to route real-time simulation data to a running FlightGear session.

New SimViewingDevice Block

The FlightGear Preconfigured 6DoF Animation block is now a SimViewingDevice. You can use this block when you have connected your model to running target code using the Real-Time Workshop external mode.

R2006a

Version: 2.1

New Features

FlightGear Version 0.9.9 Is Supported by FlightGear Simulator Interface

FlightGear Simulator Interface now supports the standard binary distributions of FlightGear version 0.9.9 on all platforms.

The FlightGear Preconfigured 6DoF Animation and Pack net_fdm Packet for FlightGear blocks have been updated accordingly.

3DoF Animation and 6DoF Animation Blocks Support Code Generation

The 3DoF Animation and 6DoF Animation blocks are now SimViewingDevices. You can view outputs with these blocks when you have connected your model to running target code using the Real-Time Workshop external mode.

R14SP3

Version: 2.0.1

No New Features or Changes

R14SP2+

Version: 2.0

New Features

Compatibility Considerations

Flight Simulator Interface

Aerospace Blockset Software Version 2.0 supports an interface to the third-party FlightGear Flight Simulator, an open source flight simulator software package. You can obtain the FlightGear Flight Simulator from www.flightgear.org.

The simulator interface included with the Aerospace Blockset software is a unidirectional transmission from the Simulink software to FlightGear using FlightGear's published `net_fdm` binary data exchange specification transmitted via UDP network packets to a running instance of FlightGear.

The Aerospace Blockset product currently supports the standard binary distributions of FlightGear versions 0.9.3 and 0.9.8a on all platforms.

Note There is a known problem with FlightGear running on Macintosh, where Weight on Wheels (`wow`) is 4 bytes, as opposed to other platforms where it is 1 byte. As a result, the Aerospace Blockset product might experience trouble communicating with FlightGear if you are running FlightGear on Macintosh, and if you are using any of the following parameters:

- `wow`
- `gear_pos`
- `gear_steer`
- `gear_compression`
- `agl`
- `cur_time`
- `warp`
- `visibility`

For more information on the available parameters, see the reference page for the Pack `net_fdm` Packet for FlightGear block.

New Aerospace Blockset Blocks

The new Simulink blocks introduced in Aerospace Blockset Software Version 2.0 are listed below:

3DoF (Wind Axes)
6 DoF ECEF (Quaternion)
6DoF Wind (Quaternion)
6DoF Wind (Wind Angles)
Simple Variable Mass 3DoF (Wind Axes)
Simple Variable Mass 6 DoF ECEF (Quaternion)
Simple Variable Mass 6DoF Wind (Quaternion)
Simple Variable Mass 6DoF Wind (Wind Angles)
Custom Variable Mass 3DoF (Wind Axes)
Custom Variable Mass 6 DoF ECEF (Quaternion)

Custom Variable Mass 6DoF Wind (Quaternion)
Custom Variable Mass 6DoF Wind (Wind Angles)
4th Order Point Mass (Longitudinal)
4th Order Point Mass Forces (Longitudinal)
6th Order Point Mass (Coordinated Flight)
6th Order Point Mass Forces (Coordinated Flight)
Direction Cosine Matrix Body to Wind
Direction Cosine Matrix Body to Wind to Alpha and Beta
Direction Cosine Matrix ECEF to NED
Direction Cosine Matrix ECEF to NED to Latitude and Longitude
Direction Cosine Matrix to Wind Angles
ECEF Position to LLA
LLA to ECEF Position
Flat Earth to LLA
Geocentric to Geodetic Latitude
Geodetic to Geocentric Latitude
Radius at Geocentric Latitude
Wind Angles to Direction Cosine Matrix
Besselian Epoch to Julian Epoch
Julian Epoch to Besselian Epoch
FlightGear Preconfigured 6DoF Animation
Generate Run Script
Pack net_fdm Packet for FlightGear
Send net_fdm Packet to FlightGear
Pilot Joystick
Simulation Pace
Three-Axis Accelerometer
Three-Axis Gyroscope
Three-Axis Inertial Measurement Unit
Quaternion Conjugate
Quaternion Division
Quaternion Inverse
Quaternion Modulus
Quaternion Multiplication
Quaternion Norm
Quaternion Normalize
Quaternion Rotation

Wind Angular Rates

World Magnetic Model 2005

Mach Number and Dynamic Pressure Blocks Input

Previously the Mach Number and Dynamic Pressure blocks worked with airspeed as an input. This was not how the blocks were intended to work. Starting with this release, these blocks only accept velocity vectors as input.

Compatibility Considerations

The Mach Number and Dynamic Pressure blocks no longer accept airspeed as an input. Use velocity vectors as input for these blocks.

R14SP2

Version: 1.6.2

No New Features or Changes

