Aerospace Blockset™ Release Notes

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No New Features or Changes

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 1-3.

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:

- $\mu_{ref} \, l_{ref}$
- 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
`computeLateralDirectionalFlyingQualities`	New function to compute lateral-directional flying qualities (roll, spiral, dutch roll modes) using a linear system state-space model.
`linearizeLongitudinalAirframe`	Name changed to `linearizeAirframe`.
`DehavillandBeaverLongitudinalFlyingQualityAnalysis.mlx`	Name changed to `DehavillandBeaverFlyingQualityAnalysis.mlx`.

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	flightControl3DOFAirframeTemplate flightControl6DOFAirframeTemplate	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	SkyHoggLongitudinalFlyingQualityAnalysis DehavillandBeaverLongitudinalFlyingQualityAnalysis	Live scripts that illustrate the flying quality analysis workflow.

Functions	`asbFlightControlAnalysis`
	
	`trimAirframe`
	
	`linearizeLongitudinalAirframe`
	
	`computeLongitudinalFlyingQualities`
		Functions that the models use during the flying quality analysis workflow.
		
		To create a new model from these templates, use the `asbFlightControlAnalysis` function.

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 ±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', 'XYX', 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 Universal Coordinated 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 Universal Coordinated 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 15-3.

- 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 Universal Coordinated 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 19-2.

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 `asbhl20` 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