



ASTOS UI Overview – Sub-Orbital Rocket Trajectory Modelling

Jason Ong



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models

Modelling

MAD_H300_ELA

- Environment
 - Default Environment
 - Celestial Bodies
 - Earth
 - Atmospheres
 - e_atmosphere
 - Hydrospheres
 - Winds
 - Wind
 - Magnetic Fields
- Vehicle Parts & Properties
 - Actuators
 - H300_20
 - Aerodynamics
 - MAD_H300_JetOff_0km
 - MAD_H300_JetOff_30km
 - MAD_H300_JetOn
 - + Aerothermodynamics
 - + Components
 - + Sensors & Transmitters
 - Power
 - Data
- Analyses
- Variables
- Optimization
- Results
- Files

Central body: Earth Atmosphere: e_atmosphere

Wind: Wind Hydrosphere: - None -

Magnetic field: - None -

Gravitational perturbation:

Third body perturbation:

Select ID

Relativistic effects:

Celestial bodies:

Select ID

Formulation: General Relativity

Solar radiation pressure: Disabled

Solar radiation torque: Disabled

Gravity gradient: Disabled

17:17:45.5 Writing model\astos\Variables.xml...
17:17:45.5 Writing model\astos\Model_Data.xml...
17:17:45.5 Writing model\astos\Model_Definition.xml...
17:17:45.5 Writing model\astos\Dynamics_Configuration.xml...
17:17:45.5 Writing model\astos\Exports.xml...
17:17:45.5 Writing model\astos\Reports.xml...
17:17:45.5 Writing model\astos\Analyses.xml...

Component Panel



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

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Modelling

MAD_H300_ELA

- Environment

Default Environment

- Celestial Bodies

Earth

- Atmospheres

e_atmosphere

- Hydrospheres

- Winds

Wind

- Magnetic Fields

- Vehicle Parts & Properties

- Actuators

H300_20

- Aerodynamics

MAD_H300_JetOff_0km

MAD_H300_JetOff_30km

MAD_H300_JetOn

+ Aerothermodynamics

+ Components

+ Sensors & Transmitters

Power

Data

Analyses

Variables

Optimization

Results

Files

Central body: Earth Atmosphere: e_atmosphere

Wind: Wind Hydrosphere: - None -

Magnetic field: - None -

Gravitational perturbation:

Third body perturbation: Select ID

Relativistic effects:

Celestial bodies: Select ID

Formulation: General Relativity

Solar radiation pressure: Disabled

Solar radiation torque: Disabled

Gravity gradient: Disabled

17:17:45.5 Writing model\astos\Variables.xml...

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17:17:45.5 Writing model\astos\Reports.xml...

17:17:45.5 Writing model\astos\Analyses.xml...

Environment Settings



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models Vehicle Models Vehicles & Other Entities

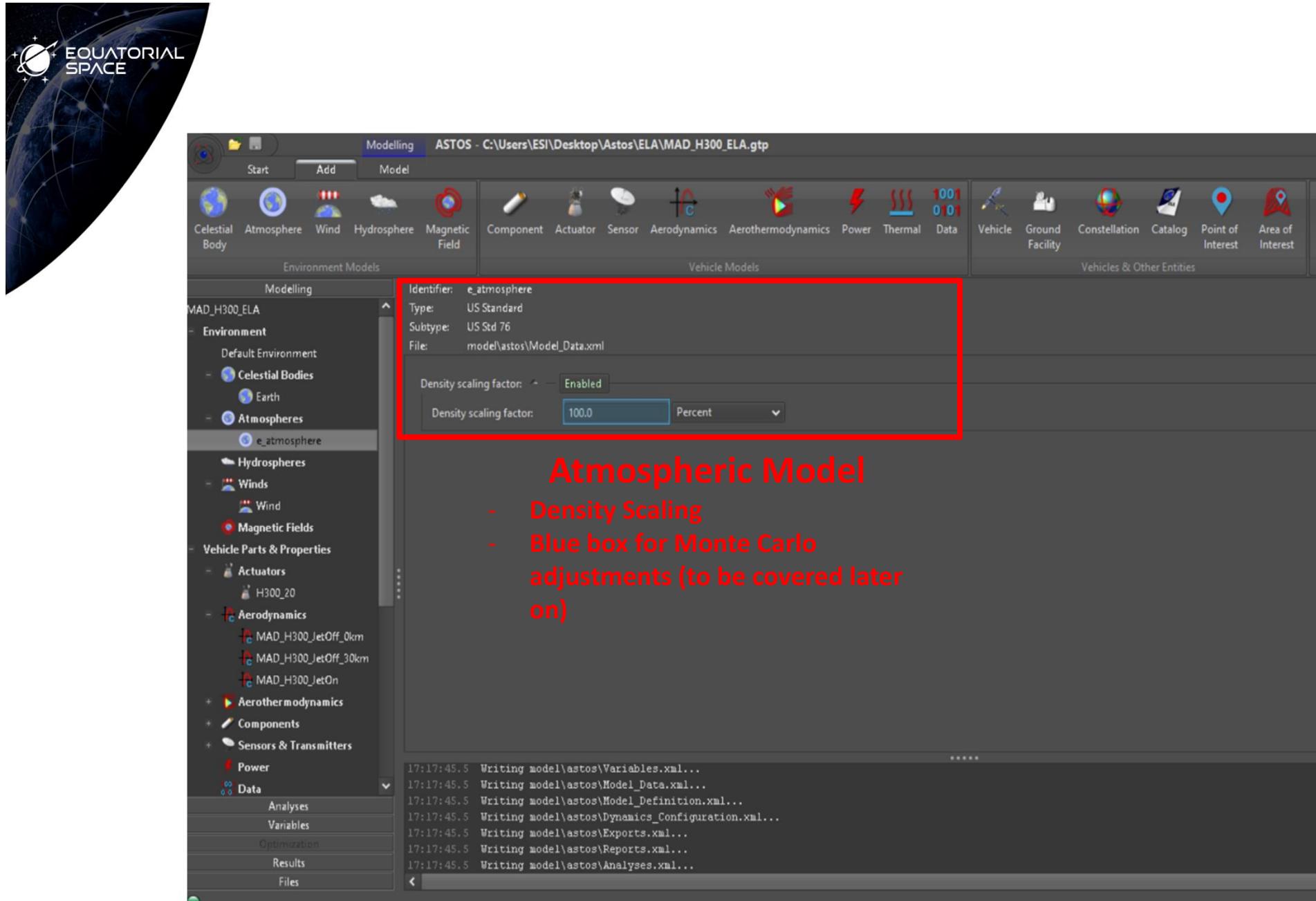
Modeling

MAD_H300_ELA

- Environment
 - Default Environment
 - Celestial Bodies
 - Earth
 - Atmospheres
 - e_atmosphere
 - Hydrospheres
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 - Power
 - Data
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 - Variables
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 - Results
 - Files

Earth Model Set-Up

```
17:17:45.5 Writing model\astos\Variables.xml...
17:17:45.5 Writing model\astos\Model_Data.xml...
17:17:45.5 Writing model\astos\Model_Definition.xml...
17:17:45.5 Writing model\astos\Dynamics_Configuration.xml...
17:17:45.5 Writing model\astos\Exports.xml...
17:17:45.5 Writing model\astos\Reports.xml...
17:17:45.5 Writing model\astos\Analyses.xml...
```



The screenshot shows the ASTOS software interface with a dark theme. The top bar displays the title "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp". The menu bar includes "Modelling", "Start", "Add", and "Model". The toolbar contains icons for "Celestial Body", "Atmosphere", "Wind", "Hydrosphere", "Magnetic Field", "Component", "Actuator", "Sensor", "Aerodynamics", "Aerothermodynamics", "Power", "Thermal", "Data", "Vehicle", "Ground Facility", "Constellation", "Catalog", "Point of Interest", and "Area of Interest".

The left sidebar shows the "Modelling" tree structure for the model "MAD_H300_ELA". The "Winds" node is selected and highlighted in red. Other nodes include "Environment", "Vehicle Parts & Properties", "Aerodynamics", "Aerothermodynamics", "Components", "Sensors & Transmitters", "Power", "Data", "Analyses", "Variables", "Optimization", "Results", and "Files".

The main panel displays the configuration for the selected "Wind" node. The "Identifier" is set to "Wind", "Type" to "Standard", and the "File" is "model\astos\Model_Data.xml". The "Wind coordinates" are set to "Cartesian". The "Wind profile" section shows "Velocity east" and "Velocity north" both defined by a value of 0.0 Meter/Second. "Velocity vertical" is set to "Disabled". "Windshear" and "Turbulences" are also disabled.

The bottom right corner of the main panel shows a log of file writes:

```
17:17:45.5 Writing model\astos\Variables.xml...
17:17:45.5 Writing model\astos\Model_Data.xml...
17:17:45.5 Writing model\astos\Model_Definition.xml...
17:17:45.5 Writing model\astos\Dynamics_Configuration.xml...
17:17:45.5 Writing model\astos\Exports.xml...
17:17:45.5 Writing model\astos\Reports.xml...
17:17:45.5 Writing model\astos\Analyses.xml...
```

Wind Profile

- Can be set in cartesian or cylindrical coordinates
- Turbulence profiles not enabled due to licensing



Modelling ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add Model

Simulate Analyze Stop Execution Log Viewer Astroview Batch-Mode Inspector Database Connections Model Structure Viewer Scenario Conversion Wizard ASTOS Help Scenario Introduction Scenario Summary Visit FAQ Send Feedback License Manager About ASTOS

Actions

Modelling

MAD_H300_ELA

- Environment
 - Default Environment
 - Celestial Bodies
 - Earth
 - Atmospheres
 - e_atmosphere
 - Hydrospheres
 - Winds
 - Wind
 - Magnetic Fields
- Vehicle Parts & Properties
 - Actuators
 - H300_20
 - Aerodynamics
 - MAD_H300_JetOff_0km
 - MAD_H300_JetOff_30km
 - MAD_H300_JetOn
 - + Aerothermodynamics
 - + Components
 - + Sensors & Transmitters
 - Power
 - Data
 - Analyses
 - Variables
 - Optimization
 - Results
 - Files

Identifier: H300_20
Type: Rocket Engine
Subtype: Profile
File: model\astos\Model_Data.xml

Thrust scaling factor: Enabled 1.0

Nozzle ae: Defined by: Value Value: 0.028353 Meter**2

Performance defined by: Vacuum thrust and Mass flow

Vacuum thrust:

Defined by: Profile

Profile:

- Interpolation type: Linear
- Ordinate data scale: Linear to Linear
- Data source: File
- Scaling factor: 1.0
- Filename: \data\MAD_H300_v1_VacT_v_Time.txt
- Skip Lines: 0

Perturbation (uncertainty): Bias: Disabled

Engine Settings

Nozzle exhaust area

Thrust data (file or manual input)

Name	Burn Time	Data
Unit	Second	Kilo-Newton
Column	1	2



Modelling ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add Model

Simulate Analyze Stop Execution Log Viewer Astroview Batch-Mode Inspector Database Connections Model Structure Viewer Scenario Conversion Wizard ASTOS Help Scenario Introduction Scenario Summary Visit FAQ Send Feedback License Manager About ASTOS

Actions

Identifier: H300_20
Type: Rocket Engine
Subtype: Profile
File: model\astos\Model_Data.xml

Engine Settings

Mass flow data (file or manual input)

Defined by: Value Value: 10.019 Kilogram/Second

Scale to fit: Disabled

Consider jet damping effect: Enabled

Unburned propellant: Disabled

Actuation damping: Disabled

Pressurization (Turbo Pump): Disabled

Structural mass: Disabled

Mass distribution: Default

Model Data

Name	Burn Time	Data
Unit	Second	Kilo-Newton
Column	1	2

Perturbation (uncertainty):

Bias: Disabled

Gain: Disabled

Mass flow:

Defined by: Value Value: 10.019 Kilogram/Second

Scale to fit: Disabled

Consider jet damping effect: Enabled

Unburned propellant: Disabled

Actuation damping: Disabled

Pressurization (Turbo Pump): Disabled

Structural mass: Disabled

Mass distribution: Default

Analyses Variables Optimization Results Files

Model Data

Name	Burn Time	Data
Unit	Second	Kilo-Newton
Column	1	2

Perturbation (uncertainty):

Bias: Disabled

Gain: Disabled

Mass flow:

Defined by: Value Value: 10.019 Kilogram/Second

Scale to fit: Disabled

Consider jet damping effect: Enabled

Unburned propellant: Disabled

Actuation damping: Disabled

Pressurization (Turbo Pump): Disabled

Structural mass: Disabled

Mass distribution: Default

Analyses Variables Optimization Results Files

The screenshot shows the ASTOS software interface with the title bar "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp". The menu bar includes "Modelling", "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp", "Start", "Add", "Model", "Actions", "Windows", and "Info". The toolbar contains icons for Simulate, Analyze, Stop, Execution Log, Viewer, Astrovew, Batch-Mode Inspector, Database Connections, Model Structure Viewer, Scenario Conversion Wizard, ASTOS Help, Scenario Introduction, Scenario Summary, FAQ, Visit, Send Feedback, License Manager, and About ASTOS.

The left sidebar navigation pane includes sections for Modelling (Winds, Magnetic Fields), Vehicle Parts & Properties (Actuators, Aerodynamics, MAD_H300_JetOff_0km, MAD_H300_JetOff_30km, MAD_H300_JetOn), Aerothermodynamics (Dorado_thermo), Components, Sensors & Transmitters (Analyses, Variables, Optimization, Results), Results (Curve Plots, Surface Plots, Condition Plots, Result Summary, Exports, MAD_H300_Compiled), Reports, and Files.

The main panel displays the "Aerodynamics moments definition" set to "Centre of Pressure Position". It shows the "Reference area" defined by "Area" with a value of "0.0754 Meter^{4/2}". The "Reference Length" is set to "0.31 Meter". The "Center of pressure" section indicates the offset is specified with respect to the global node. The "X Offset" profile is defined by "Profile" with settings for Interpolation type (Linear), Ordinate data scale (Linear to Linear), Data source (File), and Skip Lines (0). The scaling factor is set to "1.0".

A red arrow points from the text "Reference area and length" to the "Reference area" and "Reference Length" fields. Another red arrow points to the "Scaling factor" field, which is highlighted in blue.

Log messages at the bottom of the panel:

```
16:32:25.9 Writing model\astos\Analyses.xml...
16:32:25.9 Writing model\astos\Mission_Constraints.xml...
16:32:26.0 Simulate scenario
```

Aerodynamics

Reference area and
length



Modelling ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add Model

Simulate Analyze Stop Execution Log Viewer Astroview Batch-Mode Inspector Database Connections Model Structure Viewer Scenario Conversion Wizard ASTOS Help Scenario Introduction Scenario Summary Visit FAQ Send Feedback License Manager About ASTOS

Actions Windows Info

Modelling

- + Winds
- + Magnetic Fields
- Vehicle Parts & Properties
 - + Actuators
 - Aerodynamics
 - MAD_H300_JetOff_0km
 - MAD_H300_JetOff_30km
 - MAD_H300_JetOn
 - + Aerothermodynamics
 - Dorado_thermo
 - + Components
 - + Sensors & Transmitters
 - Analyses
 - Variables
 - Optimization
 - Results

Results

- Curve Plots
- Surface Plots
- Condition Plots
- Result Summary
- Exports
 - MAD_H300_Compiled
- Reports

Files

Aerodynamics

Identifier: MAD_H300_JetOff_0km
Type: Tabular
File: model\astos\Model_Data.xml
Reference Length: 0.31 Meter

Center of pressure: The offset is specified with respect to the global node!

X Offset:

Defined by: Profile

Profile: Linear

Interpolation type: Linear

Out of bounds action: Nearest Value

Ordinate data scale: Linear to Linear

Scaling factor: 1.0

Data source: File

Filename: \data\Xcp.txt

Skip Lines: 0

XCP input

Matching descriptors for file input

Name	Mach	Unit	None	Column	1	2	Data
Bias:	Disabled						
Gain:	Disabled						

16:32:25.9 Writing model\astos\Analyses.xml...
16:32:25.9 Writing model\astos\Mission_Constraints.xml...
16:32:26.0 Simulate scenario



Modelling ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add Model

Simulate Analyze Stop Execution Log Viewer Astroview Batch-Mode Inspector Database Connections Model Structure Viewer Scenario Conversion Wizard ASTOS Help

Scenario Introduction Scenario Summary Visit FAQ Send Feedback License Manager About ASTOS

Actions Windows Info

Modeling

Winds Magnetic Fields

Vehicle Parts & Properties

- Actuators
- Aerodynamics
 - MAD_H300_JetOff_0km
 - MAD_H300_JetOff_30km
 - MAD_H300_JetOn
- Aerothermodynamics Dorado_thermo
- Components
- Sensors & Transmitters

Analyses Variables Optimization Results

Curve Plots Surface Plots Condition Plots Result Summary

Exports MAD_H300_Compiled Reports

Files

Identifier: MAD.H300_JetOff_0km
Type: Tabular
File: model\astos\Model_Data.xml

Aerodynamics

Coefficients:

Type	Frame	Axis	Character
Force	Body-fixed (B)	Axial direction (-Z)	Absolute value
Force	Body-fixed (B)	Lateral direction (+Y)	Sideslip slope
Force	Body-fixed (B)	Normal direction (+X)	Angle of attack slope
Moment	Body-fixed (B)	Roll moment (+X)	Aerodynamic surface area
Moment	Body-fixed (B)	Roll moment (+X)	Body roll rate slope
Moment	Body-fixed (B)	Pitch moment (+Y)	Body pitch rate slope
Moment	Body-fixed (B)	Yaw moment (+Z)	Body yaw rate slope

Add Force Coefficient
Add Damping Coefficient
Delete Selected Coefficient

Body yaw rate slope (Moment, Body-fixed (B), Yaw moment (+Z)):

Defined by: Profile

Profile: Angle of attack reverse lookup: Disabled
Interpolation type: Linear Out of bounds action: Nearest Value
Ordinate data scale: Linear to Linear Scaling factor: -1.0
Data source: File Filename: \data\CM_Q_Deg.txt
Skip Lines: 0

Data

Name	Mach	Unit	None	Column	1	2

16:32:25.9 Writing model\astos\Analyses.xml...

Force and moment coefficients definition

File/individual data input for force/moment coefficients

The screenshot shows the ASTOS software interface with a dark theme. The top menu bar includes "Modeling", "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp", "Start", "Add", "Model", and various toolbars for simulation, analysis, and database management.

The left sidebar contains a tree view under "Modelling" with categories like Winds, Magnetic Fields, Vehicle Parts & Properties, Actuators, Aerodynamics, Aerothermodynamics, Components, Sensors & Transmitters, and Results. Under Aerodynamics, "MAD_H300_JetOff_0km" is selected.

The main workspace displays the "Aerodynamics" configuration window. It shows the identifier "MAD_H300_JetOff_0km", type "Tabular", and file path "model\astos\Model_Data.xml".

A red box highlights the "Aerodynamic surfaces" section, which includes:

- ID: Surface_1
- Add aerodynamic surface
- Delete selected aerodynamic surface

Below this, it shows the "Selected surface" with identifier "Surface_1" and deflection settings:

- Defined by: Value
- Deflection: 0.5 Degree

At the bottom of the window, a status message reads "16:32:25.9 Writing model\astos\Analyses.xml..."

Aerodynamics

Specify fin surfaces and
fin cant angle



Modeling ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add Model

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models Vehicle Models Vehicles & Other Entities

Components - Stage

Identifier: MAD_H300_S1
Type: Basic Vehicle Stage
File: model\astos\Model_Data.xml

Propellant type: Solid

Filling ratio:
 Common Individual
This specifies the scaling factor which is multiplied with the propellant mass to achieve the optimized propellant mass.

Filling ratio: 1.0 None

Dimensions: Custom
X: 4632.5 Milli-Meter
Y: 310.0 Milli-Meter
Z: 310.0 Milli-Meter

Structural mass: 139.0 Kilogram
Propellant mass: 158.0 Kilogram

Dimensions and mass specifications

Results

Curve Plots Surface Plots Condition Plots Result Summary Exports MAD_H300_Compiled Reports

Files 16:32:25.9 Writing model\astos\Analyses.xml...

The screenshot shows the ASTOS software interface for vehicle modeling. The main window displays the 'Components - Stage' configuration for a vehicle named 'MAD_H300_S1'. Key parameters shown include propellant type (Solid), filling ratio (1.0), dimensions (Custom, X: 4632.5 mm, Y: 310.0 mm, Z: 310.0 mm), structural mass (139.0 kg), and propellant mass (158.0 kg). A red box highlights the 'Dimensions' and 'Mass' sections. The left sidebar shows the project structure under 'Modelling' and 'Results'. The bottom status bar indicates file writing activity.



Modelling ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add Model

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models Vehicle Models Vehicles & Other Entities

Identifier: MAD_H300_Nosecone
Type: Auxiliary
File: model\astos\Model Data.xml

Modelling

- Dorado_thermo
- Components
 - MAD_H300_Nosecone
 - MAD_H300_S1
- Sensors & Transmitters
 - IMU
 - Power
 - Data
 - Thermal
- Vehicles & POIs Definition
 - MAD_H300
 - KTR

Analyses
Variables
Optimization
Results

Curve Plots
Surface Plots
Condition Plots
Result Summary

Exports
MAD_H300_Compiled

Reports

Files 16:32:25.9 Writing model\astos\Analyses.xml...

Components - Auxiliary

Dimensions and mass specifications

Dimensions: Custom

X: 1079.5 Milli-Meter
Y: 310.0 Milli-Meter
Z: 310.0 Milli-Meter

Shape: Cylinder
Cylinder axis: X

Total mass: 9.0 Kilogram
Mass distribution: Default

The screenshot shows the ASTOS software interface for vehicle modeling. The top bar displays the title "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp". The toolbar includes icons for Start, Add, Model, Celestial Body, Atmosphere, Wind, Hydrosphere, Magnetic Field, Component, Actuator, Sensor, Aerodynamics, Aerothermodynamics, Power, Thermal, Data, Vehicle, Ground Facility, Constellation, Catalog, Point of Interest, Area of Interest, and Physics.

The left sidebar contains sections for Modelling, Components (MAD_H300_Nosecone, MAD_H300_S1), Sensors & Transmitters (IMU, Power, Data, Thermal), Vehicles & POIs Definition (MAD_H300, KTR), Dynamics Configuration (Analyses, Variables, Optimization, Results), and Results (Curve Plots, Surface Plots, Condition Plots, Result Summary, Exports, Reports). The "Analyses" section is currently selected.

The central workspace is divided into three main areas:

- Component Inclusion:** A tree view of the vehicle structure under "Vehicle Structure". The structure is as follows:
 - MAD_H300
 - Nosecone
 - MAD_Nosecone [MAD_H300_Nosecone]
 - S_1
 - MAD_Engine [H300_20]
 - MAD_S1 [MAD_H300_S1]Nodes "MAD_Nosecone" and "MAD_S1" are highlighted with red boxes.
- Vehicle Definition:** A "Vehicle Preview" toolbar with icons for rotation, zoom, and selection, and a dropdown menu "Use data from initial guess".
- Node Visualization:** A 3D visualization of the vehicle structure. The nose cone is shown as a blue cone, and the S1 stage is shown as a red cylinder. A coordinate system (x, y, z) is displayed at the base of the S1 stage.

A red box highlights the "Node Placement" dialog box in the bottom-left corner, which contains the following settings:

Reference element:	MAD_S1
Reference node:	Bottom (-x)
Pre-rotation position offset:	X: 0.0 Meter, Y: 0.0 Milli-Meter, Z: 0.0 Milli-Meter
Nominal orientation:	XYZ
Rotation sequence:	XYZ

At the bottom of the interface, a status bar displays the message "16:32:25.9 Writing model\astos\Analyses.xml...".

Vehicle Definition

X Offset values are measured from global node

Global node

Vehicle Preview

Vehicle Structure

- MAD_H300
- Nosecone
- S.1
- Engine [H300_20]
- MAD_S1 [MAD_H300_S1]

Placement Visualization

Anchor node: Bottom (-x)

Reference element: Global

Pre-rotation position offset:

- X: 0.0 Meter
- Y: 0.0 Meter
- Z: 0.0 Meter

Nominal orientation:

Rotation sequence: XYZ

Identifier: MAD.H300
Type: Rocket
File: model\astos\Model_Definition.xml

Modeling

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Dyn

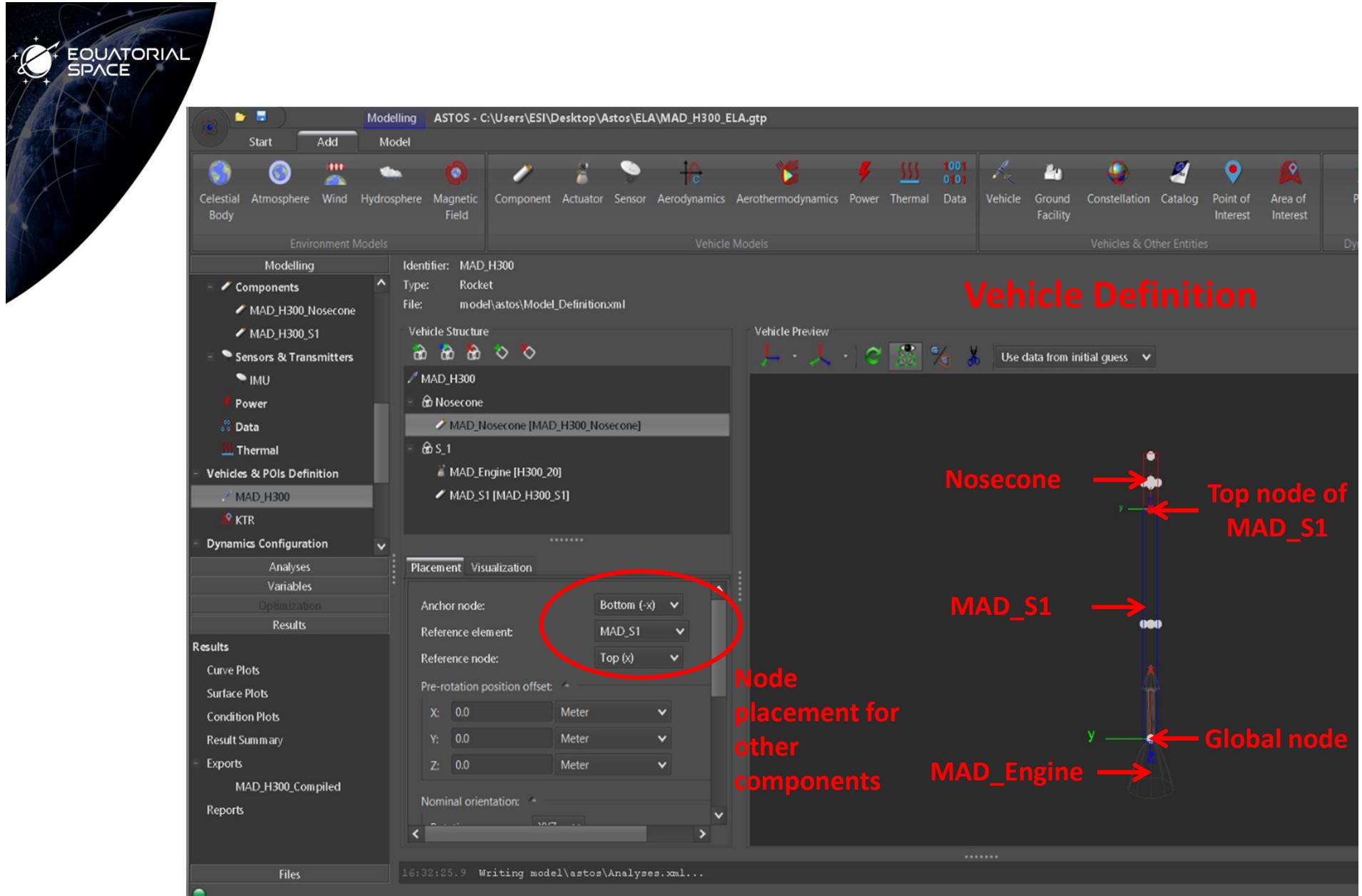
Analyses Variables Optimization Results

Curve Plots Surface Plots Condition Plots Result Summary

Exports MAD_H300_Compiled Reports

Files

16:32:25.9 Writing model\astos\Analyses.xml...



Phase Settings

Temporal discretization

“Checked” status – to be computed

The screenshot shows the ASTOS software interface with the following details:

- Top Bar:** Shows the title "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp" and various toolbars for environment models (Celestial Body, Atmosphere, Wind, Hydrosphere, Magnetic Field), vehicle models (Component, Actuator, Sensor, Aerodynamics, Aerothermodynamics, Power, Thermal, Data), and other entities (Vehicle, Ground Facility, Constellation, Catalog, Point of Interest, Area of Interest).
- Left Sidebar:** Contains sections for Modelling, Vehicles & POIs Definition (with entries MAD_H300 and KTR), Dynamics Configuration (with Phases & Common Settings, Ignition, Rail, Thrust, Coast, Coast_Above30km), Vehicles & POIs Dynamics (with MAD_H300), Analyses, Variables, Optimization, and Results.
- Mission Start Date:** Set to Year: 2000, Month: 1, Day: 1, Hour: 0, Minute: 0, Second: 0.0, with Time standard: TT and Date format: Calendar Date.
- Independent Variable:** Set to Time (t).
- Default Simulation Settings:**
 - Integration: Method: Dormand-Prince 4/5, Error: 1.0E-8.
 - Step Size: Normalized step size: Enabled, Minimum step size: 1.0E-10, Maximum step size: Disabled.
 - Ignore minimum step size warning: Enabled.
- Output Spacing:** Specified by: Interval length, Interval length: 0.05 [Second].
- Phases:** A table showing phases with checked status:

Use	Index	Phase ID	Description
<input checked="" type="checkbox"/>	1	Ignition	
<input checked="" type="checkbox"/>	2	Rail	
<input checked="" type="checkbox"/>	3	Thrust	
<input checked="" type="checkbox"/>	4	Coast	
<input checked="" type="checkbox"/>	5	Coast_Above30km	
- Log:** Shows the message "16:32:25.9 Writing model\astos\Analyses.xml..."

The screenshot shows the ASTOS software interface with the title bar "ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp". The left sidebar contains sections for Modelling, Vehicles & POIs Definition, Dynamics Configuration, Vehicles & POIs Dynamics, Results, and Files. The main area has tabs for Start, Add, and Phase, with the Phase tab selected. The toolbar includes icons for Celestial Body, Atmosphere, Wind, Hydrosphere, Magnetic Field, Component, Actuator, Sensor, Aerodynamics, Aerothermodynamics, Power, Thermal, Data, Vehicle, Ground Facility, Constellation, Catalog, Point of Interest, and Area of Interest.

Phase Settings

Specify length of phase (based on duration or end-point using mission time)

Boolean condition for end-of-phase

The Phase Settings panel shows the following configuration:

- Description: Phase span defined by: Mission Time 2.0 Second
- Additional phase end conditions: Enabled
- Position:
 - Is active: Enabled
 - Vehicle ID: MAD_H300
 - Phase ends if: value equal or greater than reference Reference: 10.0 Meter
 - Constraint applies to:
 - Default configurations: Apply configuration
 - Frame: PCPF
 - Representation: Spherical
 - Coordinate: Altitude
- Add
- Simulation settings: Default

At the bottom, a status message reads: 16:32:25.9 Writing model\astos\Analyses.xml...



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models

Modelling

Vehicles & POIs Definition

- MAD_H300
- KTR

Dynamics Configuration

- Phases & Common Settings
 - Ignition
 - Rail
 - Thrust
 - Coast
 - Coast_Above30km
- Vehicles & POIs Dynamics
 - MAD_H300
 - Analyses
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Results

- Curve Plots
- Surface Plots
- Condition Plots
- Result Summary
- Exports
 - MAD_H300_Compiled
- Reports

Files

Initial State Default Settings Ignition Rail Thrust Coast Coast_Above30km

Dynamics Settings

State type: Position & Velocity

Position:

Frame: PCPF Representation: Polar

Altitude type: Altitude Latitude type: Latitude

Reference point: Global

Altitude: 0.0 Meter

Longitude: 136.796342 Degree

Latitude: -12.389436 Degree

Initial lat, long, alt specification

Velocity:

Reference frame: Relative PCPF Representation frame: L

Speed: 0.0 Kilo-Meter/Seco...

Inclination: 85.0 Degree

Heading: 225.0 Degree

Launch angle and azimuth

Epoch differs from mission start date: Disabled

16:32:25.9 Writing model\astos\Analyses.xml...



Dynamics Settings

Aerodynamics

Environment specifications

The screenshot shows the ASTOS software interface for dynamics settings. The left sidebar contains navigation links for Celestial Body, Atmosphere, Wind, Hydrosphere, Magnetic Field, Component, Actuator, Sensor, Aerodynamics, Aerothermodynamics, Power, Thermal, Data, Vehicle, Ground Facility, Constellation, Catalog, Point of Interest, Area of Interest, and Results. The main window displays the 'Dynamics Settings' tab, which includes sections for Aerodynamics configuration (MAD_H300_JetOn), Aerothermodynamics configuration (Dorado_thermo), Environment (Central body: Earth, Atmosphere: e_atmosphere, Wind: Wind, Hydrosphere: -None-, Magnetic field: -None-), and Gravitational perturbation. A red box highlights the Aerodynamics and Environment sections.

ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300.ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models

Modelling

Vehicles & POIs Definition

- MAD_H300
- KTR

Dynamics Configuration

- Phases & Common Settings
 - Ignition
 - Rail
 - Thrust
 - Coast
 - Coast_Above30km
- Vehicles & POIs Dynamics
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Results

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Files

Initial State Default Settings Ignition Rail Thrust Coast Coast_Above30km

Environment: Default As Previous Phase Individual

Aerodynamics configuration: MAD_H300_JetOn

Aerothermodynamics configuration: Dorado_thermo

Maneuver at beginning of phase:

Impulse: Disabled

Spin impulse: Disabled

Environment:

Central body: Earth Atmosphere: e_atmosphere

Wind: Wind Hydrosphere: - None -

Magnetic field: - None -

Gravitational perturbation:

Select	ID

Third body perturbation:

Select	ID

Relativistic effects:

Select	ID

Celestial bodies:

Select	ID

Formulation: General Relativity

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ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

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Modelling

Vehicles & POIs Definition

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- Result Summary

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Initial State Default Settings Ignition Rail Thrust Coast Coast_Above30km

equations of motion:

Defined by: Inertial Velocity

Attitude:

Defined by: Euler Angles

Control/State: State

Coordinate frame: L

Magnetic moment: Disabled

Mass Distribution: Custom

Structure and consumables: Combined

Combined:

Center of mass:

X Offset

Defined by: Profile

Profile X_Offset:

Interpolation type: Linear

Out of bounds action: Nearest Value

Ordinate data scale: Linear to Linear

Scaling factor: 1.0

Data source: Local

Preview

Name	Time	Data
Unit	Second	Meter
1	0.0	2.232
2	15.77	2.14

16:32:25.9 Writing model\astos\Analyses.xml...

Dynamics Settings

Equations of motion

Attitude Control

CG input



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Modelling

- Vehicles & POIs Definition
 MAD_H300
 KTR

- Dynamics Configuration

- Phases & Common Settings
 Ignition
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 Coast_Above30km

- Vehicles & POIs Dynamics
 MAD_H300

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Results

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Initial State Default Settings Ignition Rail Thrust Coast Coast_Above30km

Dynamics Settings

CG Input (Y and Z Offsets)

Y Offset
Defined by: Value Value: 0.0 Milli-Meter

Z Offset
Defined by: Value Value: 0.0 Milli-Meter

Moments of inertia: XX

Defined by: Profile

Profile XX:

Interpolation type: Linear Out of bounds action: Nearest Value

Ordinate data scale: Linear to Linear Scaling factor: 1.0

Data source: Local

Preview

Name	Time	Data
Unit	Second	Kilogram*Meter**2
1	0.0	4.1845
2	15.77	1.8019
*		

Perturbation (uncertainty):

Bias: Disabled

Gain: Disabled

16:32:25.9 Writing model\astos\Analyses.xml...

The screenshot shows the ASTOS software interface for vehicle dynamics configuration. A red box highlights the 'CG Input (Y and Z Offsets)' section, which includes fields for defining Y and Z offsets with values of 0.0 and units of Milli-Meter. Another red box highlights the 'MOI Input XX' section, which shows the definition of moments of inertia through a profile. This profile is a linear interpolation between two data points: at time 0.0, the value is 4.1845 Kilogram*Meter**2; and at time 15.77, the value is 1.8019 Kilogram*Meter**2. The software's status bar at the bottom indicates it is writing the 'Analyses.xml' file.



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models

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- MAD_H300
- KTR

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Initial State Default Settings Ignition Rail Thrust Coast Coast_Above30km

Dynamics Settings

**MOI Input YY
(Same for ZZ)**

YY

Defined by: Profile

Profile YY:

Interpolation type: Linear Out of bounds action: Nearest Value

Ordinate data scale: Linear to Linear Scaling factor: 1.0

Data source: Local

Preview

Name	Time	Data
1	0.0	1285.77
2	15.77	523.84
*		

Perturbation (uncertainty):

Bias: Disabled

Gain: Disabled

ZZ

Defined by: Profile

Profile ZZ:

Interpolation type: Linear Out of bounds action: Nearest Value

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ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

Start Add

Celestial Body Atmosphere Wind Hydrosphere Magnetic Field Component Actuator Sensor Aerodynamics Aerothermodynamics Power Thermal Data Vehicle Ground Facility Constellation Catalog Point of Interest Area of Interest

Environment Models Vehicle Models Vehicles & Other Entities

Modelling

- Vehicles & POIs Definition
 MAD_H300
 KTR

- Dynamics Configuration

- Phases & Common Settings
 Ignition
 Rail
 Thrust
 Coast
 Coast_Above30km

- Vehicles & POIs Dynamics
 MAD_H300

Analyses Variables Optimization Results

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Initial State Default Settings Ignition Rail Thrust Coast Coast_Above30km

Perturbation (uncertainty):

Bias: Disabled
Gain: Disabled

XY
Defined by: Value Value: 0.0 Kilogram*Meter²...

XZ
Defined by: Value Value: 0.0 Kilogram*Meter²...

YZ
Defined by: Value Value: 0.0 Kilogram*Meter²...

Flexible dynamics: Disabled

Auxiliary states:

Horizontal range: Disabled Trajectory smoothness: Disabled

Velocity increment (delta V): Disabled Total impulse: Disabled

Drag loss: Disabled Gravity loss: Disabled

Steering loss: Disabled Ozone load: Disabled

Heat load: Disabled

Average drag deviation: Disabled

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Dynamics Settings

MOI Input XY, XZ,
YZ



ASTOS - C:\Users\ESI\Desktop\Astos\ELA\MAD_H300_ELA.gtp

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Aerodynamics configuration: Default As Previous Phase Individual

Aerothermodynamics configuration: Default As Previous Phase Individual

Maneuver at Beginning of Phase: Default As Previous Phase Individual

Environment: Default As Previous Phase Individual

Equations of motion: Default As Previous Phase Individual

Attitude: Default As Previous Phase Individual

Magnetic moment: Default As Previous Phase Individual

Mass Distribution: Default As Previous Phase Individual

Flexible dynamics: Default As Previous Phase Individual

Aerodynamics configuration: MAD_H300_JetOn

Aerothermodynamics configuration: Dorado_thermo

Select ID
 MAD_Engine [1/1]

Select Assembly ID
 Nosecone
 S_1 [0/2]

Jettisoned assemblies at end of phase:

Active actuators:

Maneuver at beginning of phase:

Impulse: Disabled

Spin impulse: Disabled

16:32:25.9 Writing model\astos\Analyses.xml...

Dynamics Settings

Dynamics customization depending on phases