

FLIGHTSTREAM®

Version 2020.2 New Features & Enhancements

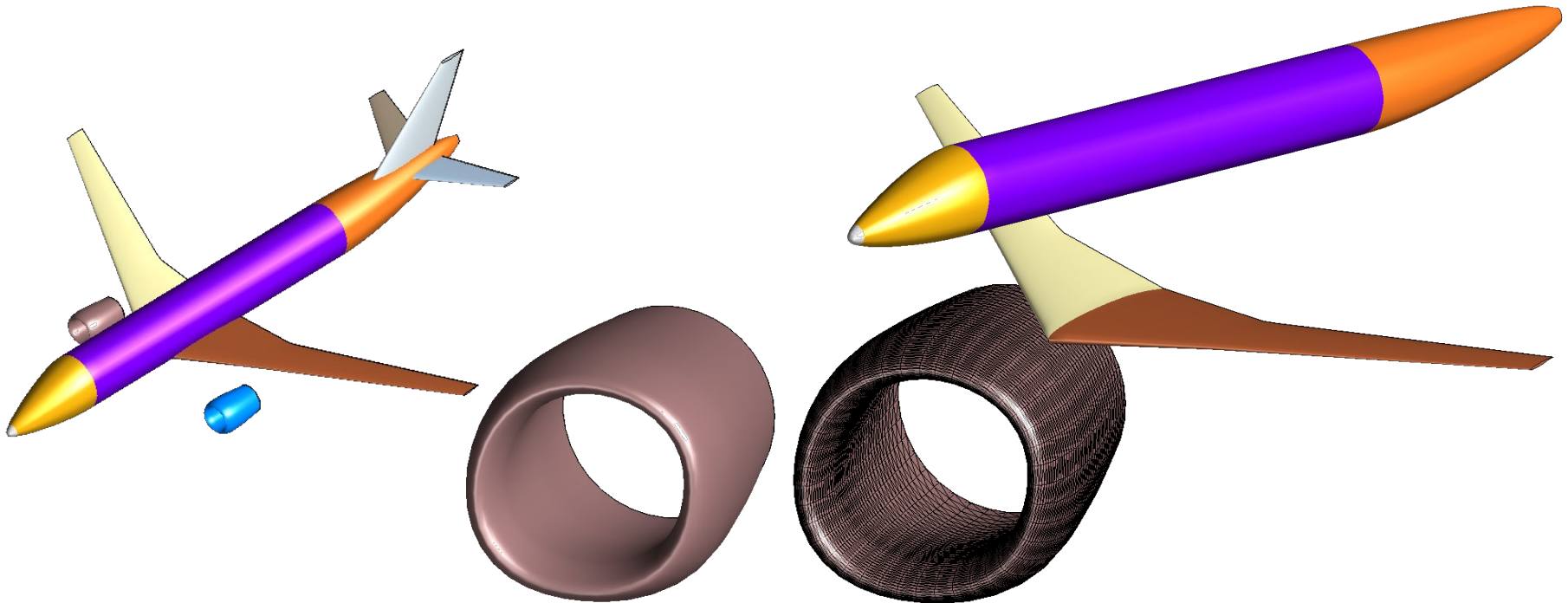
NEW



GEOMETRY IMPORT

CUSTOM CROSS-SECTION (CCS) FILE FORMAT

- New custom geometry import format (*.csv text files).
- Allows users to define components via cross-sections and let FlightStream perform automatic best-practices-driven meshing for each component type.
- No CAD required. Free-form surface lofting and design; fully automated.
- Ability to define fuselages, complex 3D wings, nacelles, pods, control surfaces, hinges and other component types.
- Can be loaded via scripting within automated MDAO pipelines.



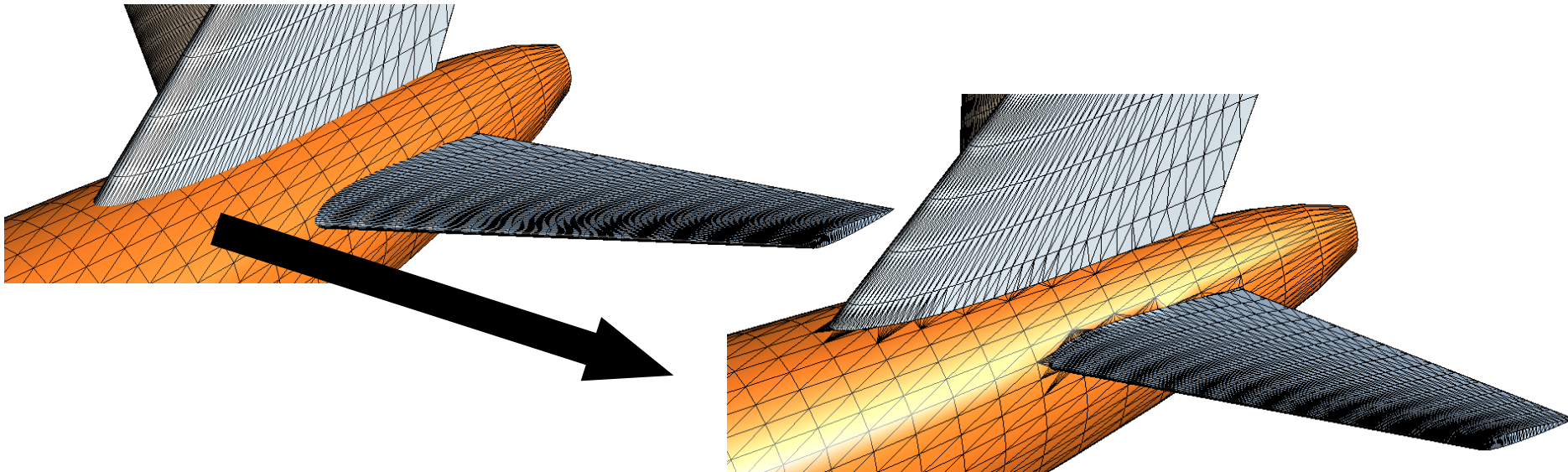
NEW



GEOMETRY OPERATION

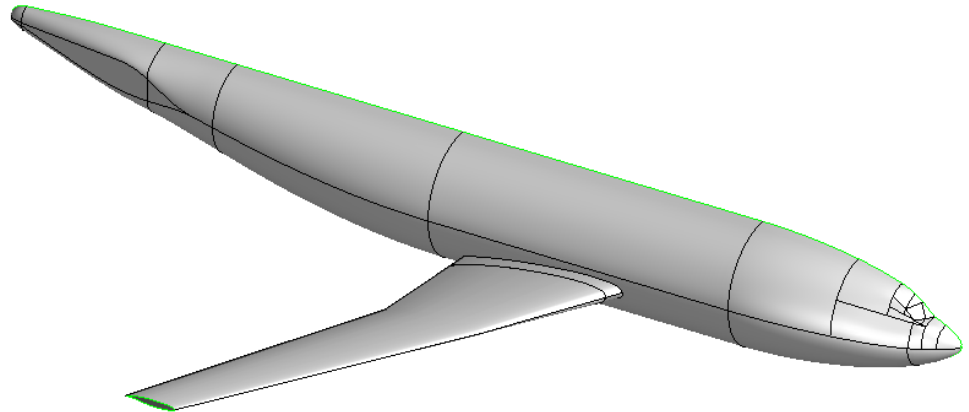
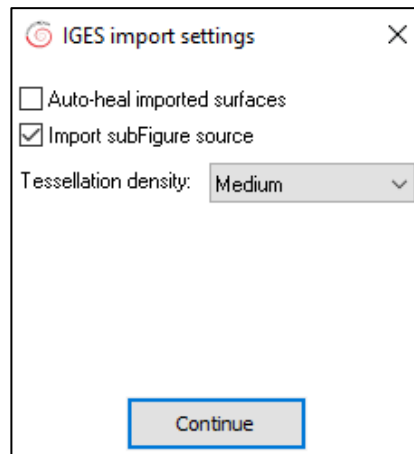
BOOLEAN UNITE

- Unite 3D components in space using the new unite operation.
- Operation works on all mesh types: CAD, CCS, OpenVSP, custom and imported meshes from Pointwise, ANSA, etc.
- Point-and-click operation to combine spatially positioned components.
- Allows mix-and-match of components and allows users to create complex geometry in CAD, and a simplified parametrized geometry in other tools and combine them for the complete OML.
- Automatically deletes all interior components: leaves the exterior wetted surface of the geometry.



IGES CAD IMPORT OPTIONS

- New import feature to auto-heal poorly exported CAD faces prior to import.
- New CAD tessellation density control option allows for initial tessellation densities in the following modes:
 - Low (~10,000 triangles)
 - Medium (~25,000 triangles)
 - High (> 50,000 triangles)



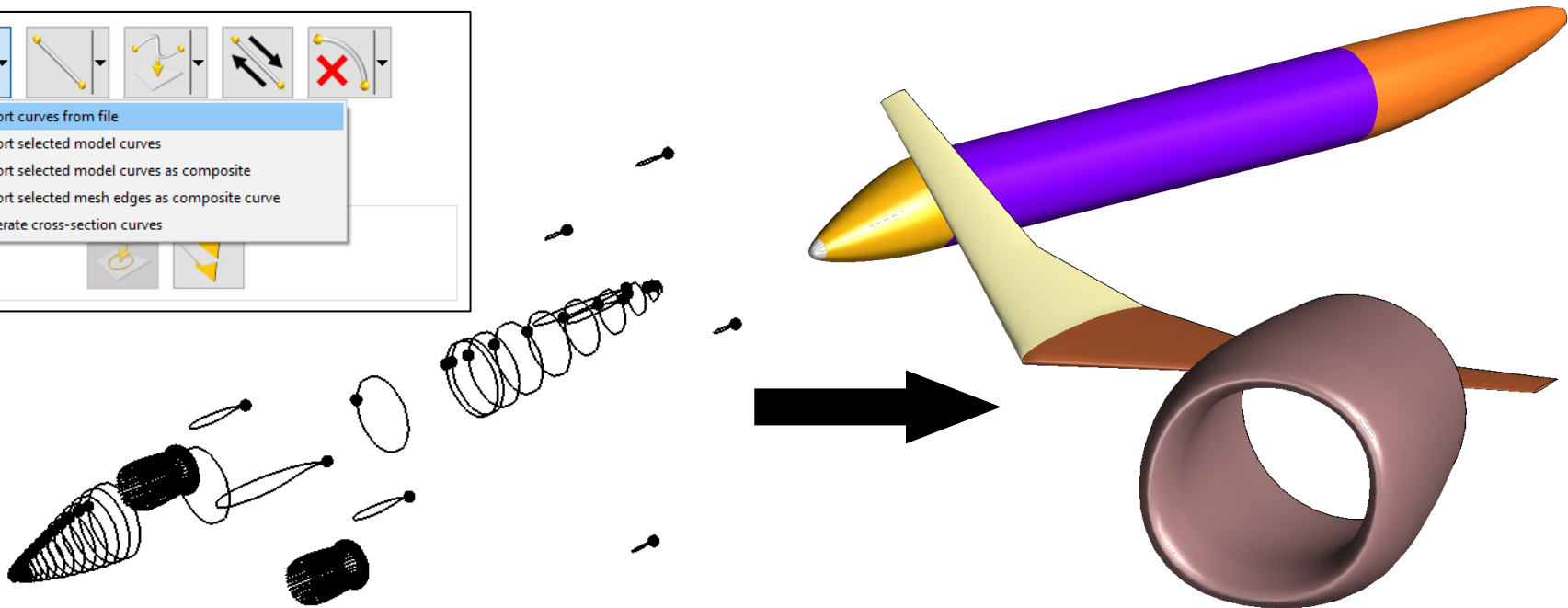
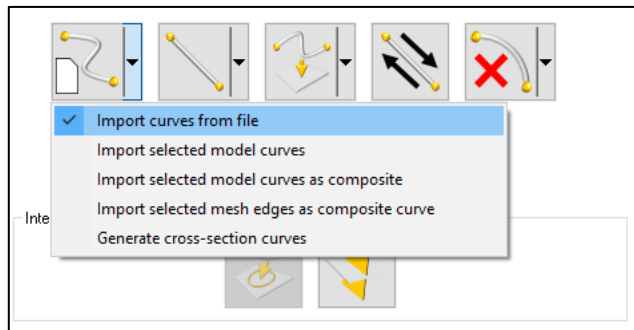
NEW



CAD IMPORT

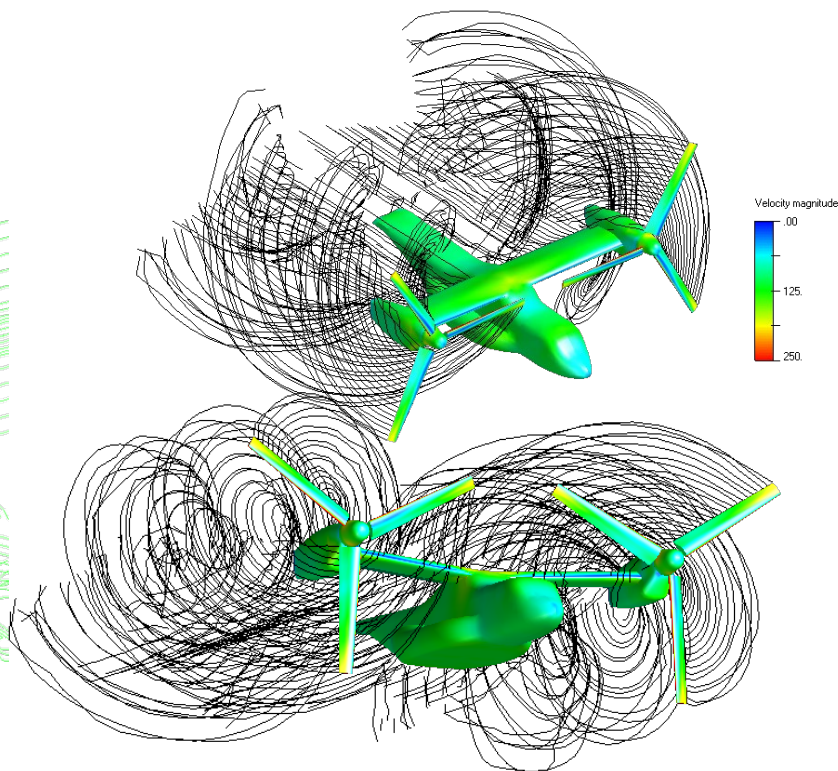
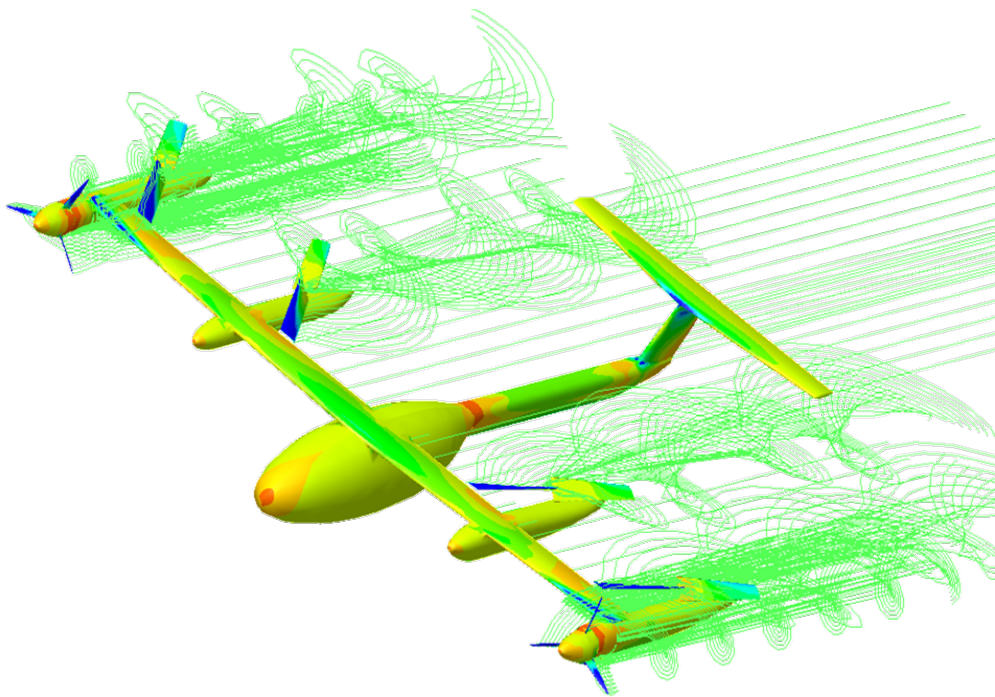
CUSTOM CROSS-SECTION (CCS) FILE FORMAT

- CAD Create tools can now import the new CCS geometry format (*.csv text files).
- Converts cross-section data in CCS geometry file into 3D drawing curves in the CAD Create panel.
- Users can then generate clean lofts of their components in FlightStream.
- Allows users to custom mesh their geometry using existing CAD-based meshing tools in FlightStream.



SOLVER: UNSTEADY WAKES

- New full-unsteady, time-evolving relaxed wake model.
- Ability to resolve around solid bodies.
- Vortex stretching, disintegration models.
- Ability to work with any type of unsteady simulation: 6DOF, gust modeling, ducted rotors, propellers and custom motion types (sudden accelerations, translation, flapping motions etc.).
- Ability to enable/disable wake relaxation.

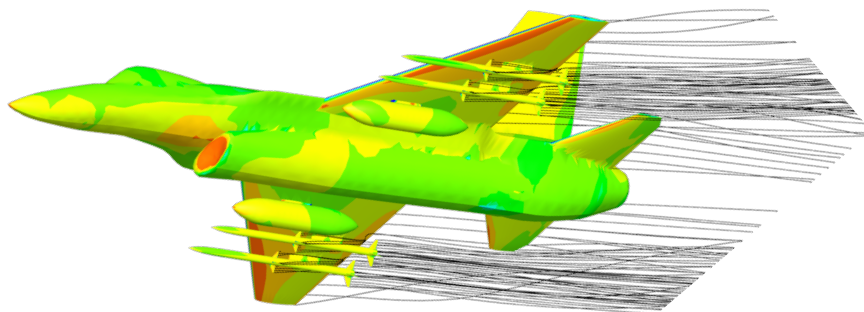


NEW



MOTION DEFINITIONS

- Enhanced rotor/propeller motion definitions with integrated, iterative, induced velocity computation models.
- New 6DOF motion definition capable of full vehicle and component-level motions.
- Ability to link to individual boundaries or boundary groups.
- Ability to work within user-defined arbitrary coordinate systems.
- Specify motion start times for staggered motion startups.
- Create multi-motion simulations with different motion types.
- Enables multi-rotor unsteady simulation of DEP vehicles.
- Fully scripted motions: new scripting API
- Fully integrated with new unsteady solver.



6DOF Motion

Edit motion definition

Coordinate system: Reference

Start time (sec): .000

Mass (kg): 1.000

Moments of inertia (kg-m²): .000, .000, .000

Products of inertia (kg-m²): .000, .000, .000

Gravity vector (m/sec²): .000, .000, .000

Done

Euclidean Motion

Edit motion definition

Coordinate system: Reference

Start time (sec): .000

Velocity (m/sec): .000, .000, .000

Acceleration (m/sec²): .000, .000, .000

Angular velocity (rad/sec): .000, .000, .000

Angular acceleration (rad/sec²): .000, .000, .000

☒ Relaxed unsteady wake motion

☒ Motion is rotor/propeller

Rotor axis: X

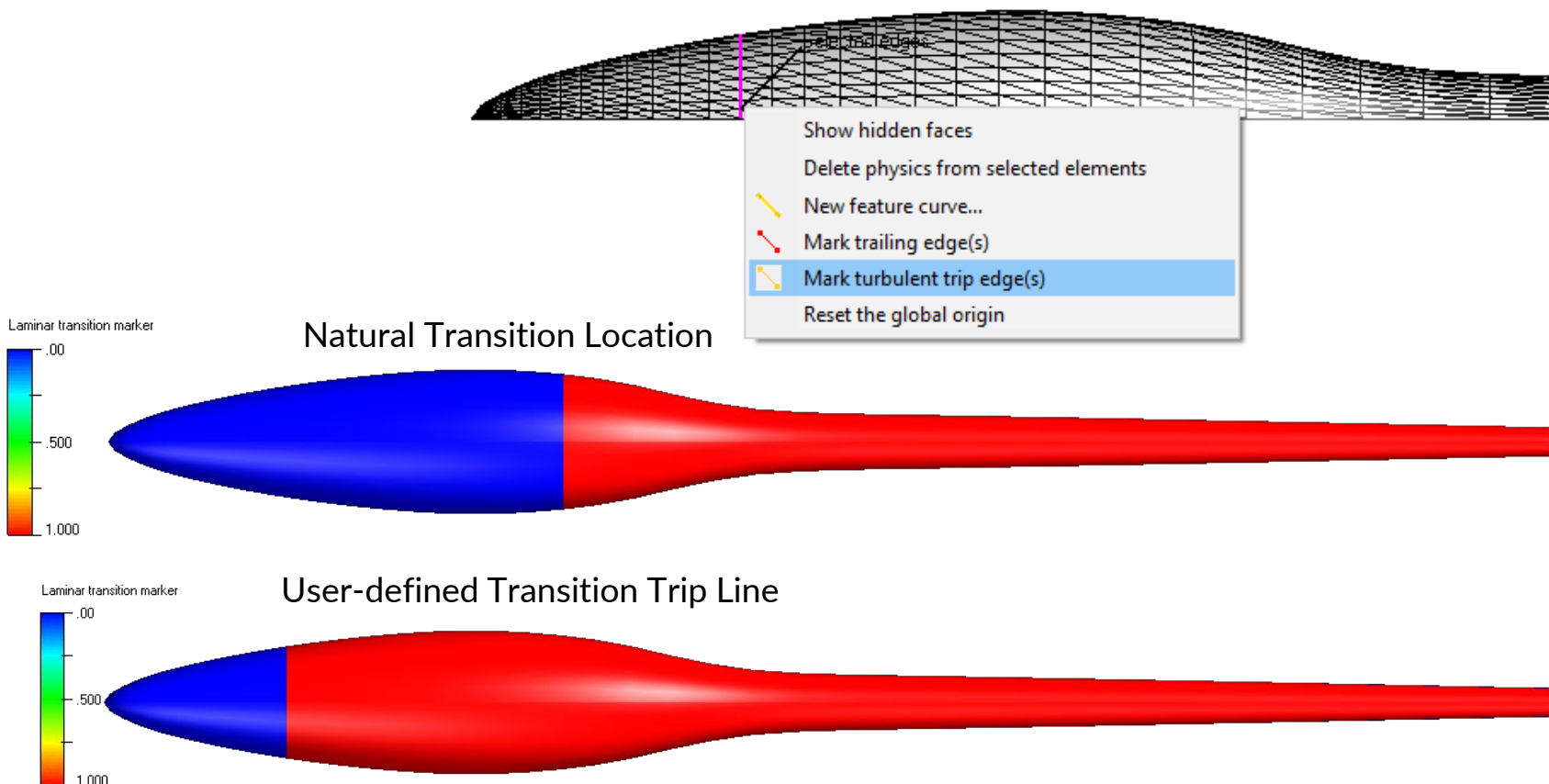
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NEW



TURBULENT TRIPS: ARTIFICIAL BOUNDARY LAYER TRANSITION LINES

- New feature enables user-defined transition trip locations for boundary layer.
- Select mesh edges as turbulent trip edges to trigger artificial boundary layer transitions.

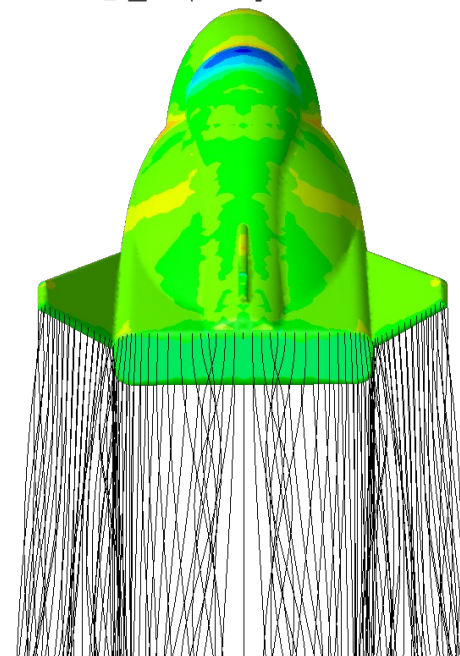
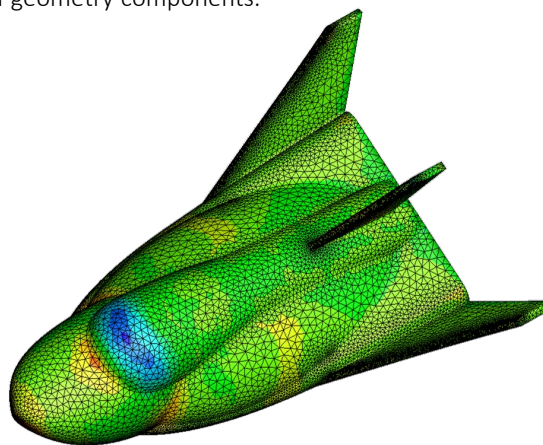
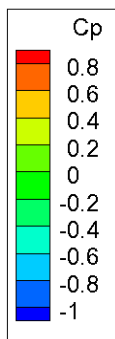
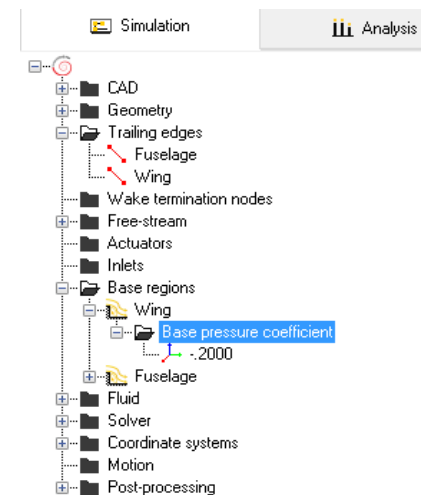


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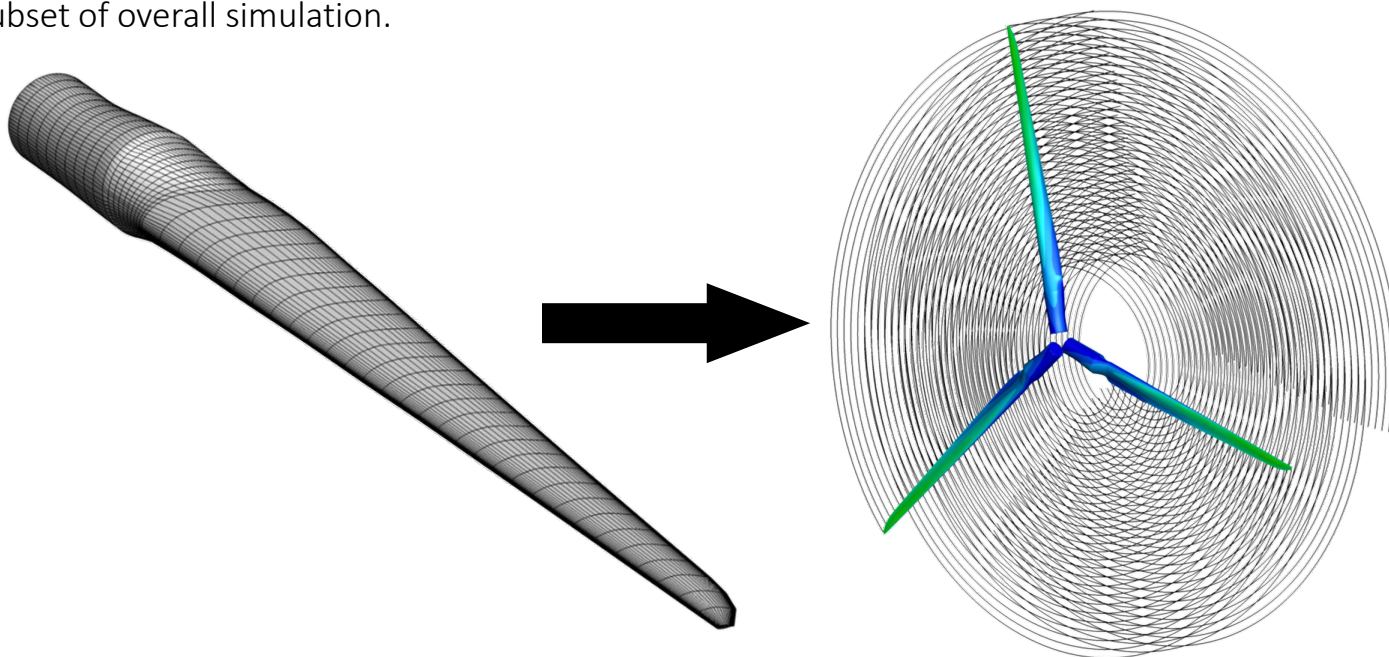
BASE FLOWS: MODELING OF BLUNT TRAILING EDGES

- A base region boundary model for FlightStream® has been added in 2020.2.
- The implementation allows the user to mark geometry surfaces as base regions either individually (per-component) or collectively.
- The user specifies a static pressure coefficient for the base region as an input condition.
- The velocity on these faces is computed from the separated vortex wake strands on the perimeter of the base regions.
- The resulting total pressure is substantially lower than that of the freestream, which contributes to the drag coefficient on the vehicle.
- The user is able to mark base region boundaries in FlightStream® in one of three ways:
 - Manually marking base regions from existing geometry surfaces.
 - Automatic detection of base regions over the entire geometry.
 - Automatic detection of base regions over selected geometry components.



PERIODIC SYMMETRY: MULTI-BLADE PROPELLERS IN STEADY ROTARY FLOW

- New feature enables definition of periodic symmetry options for the steady rotary flow solver.
- Enables users to define 1 rotor/propeller blade geometry and simulate a multi-blade setup by specifying symmetric number of blades in solver initialization.
- Massive performance benefits over simulation involving all blade geometries.
 - Speedup of 75% of solver speed per blade added via periodic symmetry.
- Substantially lower user setup time: only one propeller blade geometry needs to be meshed.
- Substantially lower memory requirements: physical mesh memory requirements restricted to small subset of overall simulation.



BOUNDARY LAYER: SURFACE ROUGHNESS MODEL

- New model developed by Olsen* modifies the Integral Boundary Layer skin friction equation to include surface roughness height.
- Modified skin friction model fed back into original boundary layer equations in FlightStream.
- Leads to roughness effects modeled in boundary layer transition, flow separation and viscous drag computation.

Skin friction coefficient C_f is defined by the equation:

$$C_f = \frac{0.90e^{-2.40H}}{(|\log_{10}Re_{\theta} - \log_{10}Re_k + 1.11|)^{2.45 - 0.15H}}$$

Reynolds Number based on the momentum thickness Re_{θ}

Reynolds Number based on the roughness height Re_k

Shape Factor H

The skin friction coefficient C_f is used in the following equation:

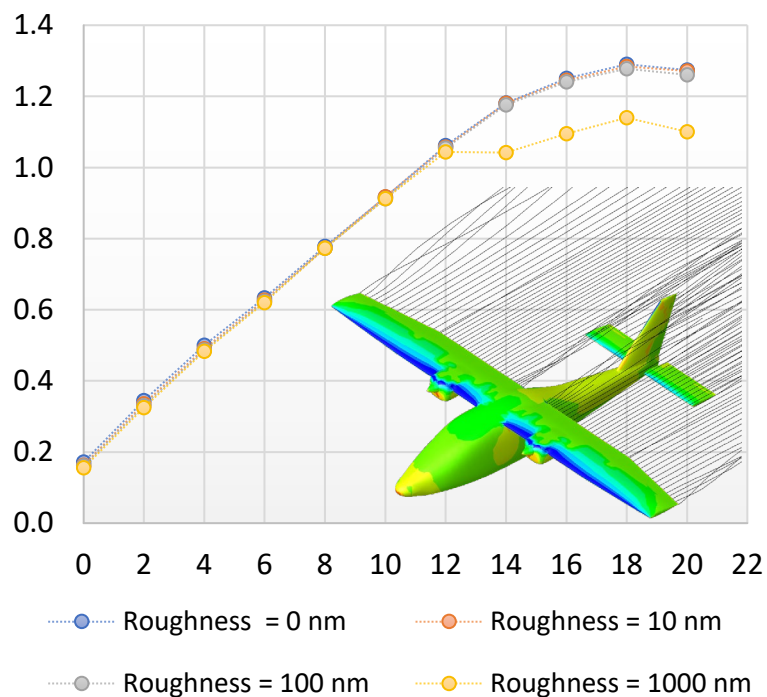
$$\frac{d\theta_i}{dX} = -\frac{\theta_i}{M_e} \frac{dM_e}{dX} (2 + H_{TR}) + \frac{dx}{dX} \frac{C_f}{2} \left(\frac{T_e}{T_0}\right)^3$$

NEW

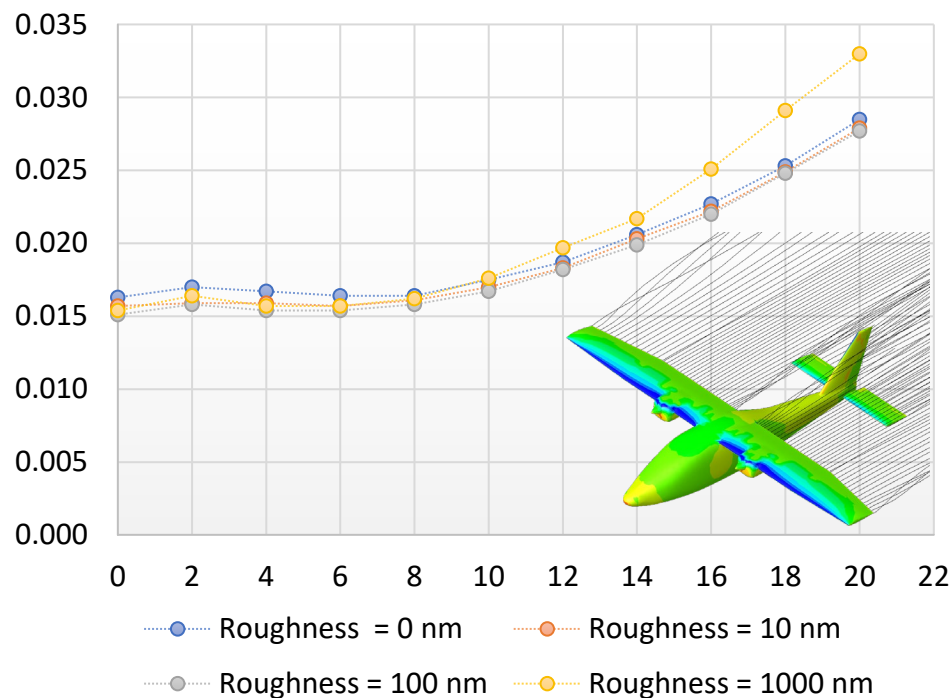


BOUNDARY LAYER: SURFACE ROUGHNESS MODEL (CONTINUED)

Lift coefficient



Viscous Drag coefficient



ENABLE/DISABLE SOLVER BOUNDARIES IN ANALYSIS

- New feature allows users to enable or disable specific boundaries during the aerodynamic loads and moment computations.
- Easy-to-use feature offers a simple checkbox that can be toggled in the analysis spreadsheet.
- Allows users to maintain specific boundaries in the simulation (such as wind tunnel walls, etc.) but disable their contribution to the overall loads on the geometry of interest.

Boundary	CL	CDi	CDo	CMy
<input checked="" type="checkbox"/> Fuselage	+0.1268	+0.0000	+0.0047	-0.0203
<input checked="" type="checkbox"/> Stabilizer	+0.1043	+0.0159	+0.0014	-0.5949
<input checked="" type="checkbox"/> Wing	+1.3559	+0.0900	+0.0144	-3.3096
Total	+1.5870	+0.1059	+0.0205	-3.9248



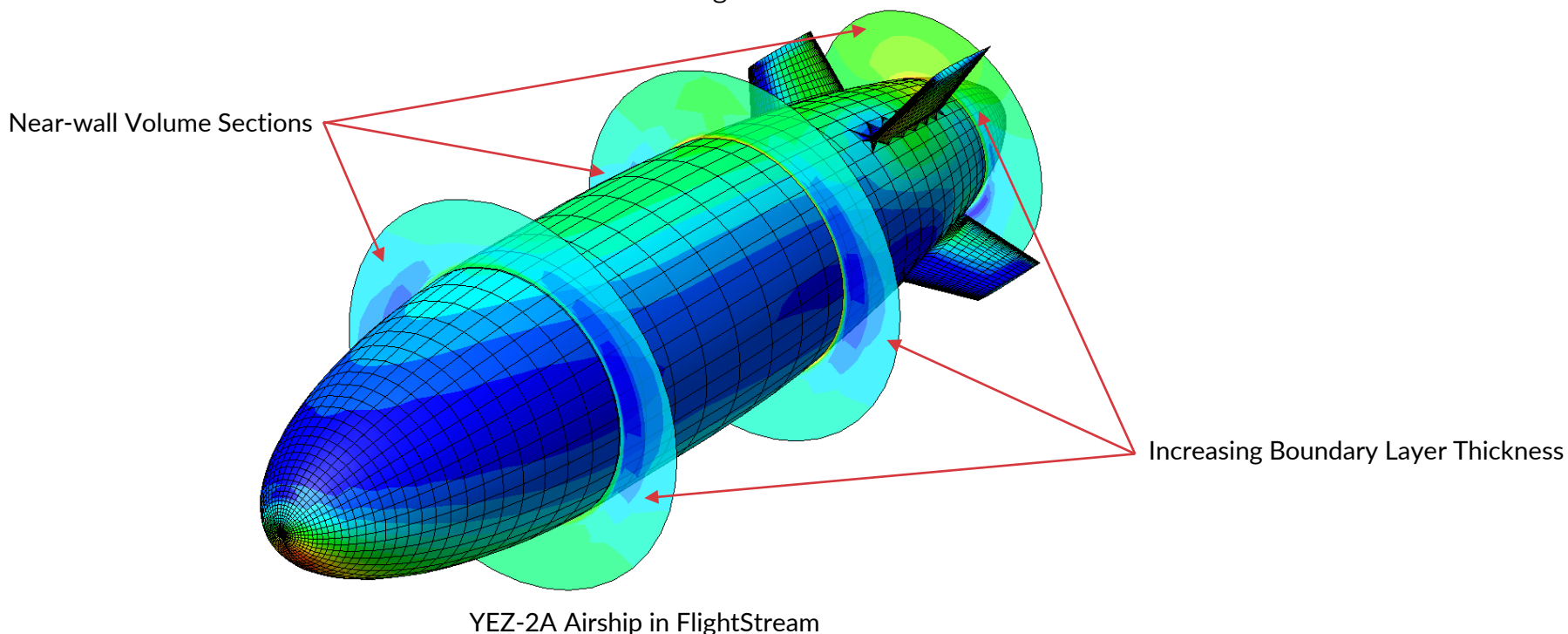
Boundary	CL	CDi	CDo	CMy
<input checked="" type="checkbox"/> Fuselage	+0.1226	+0.0000	+0.0045	-0.0202
<input type="checkbox"/> Stabilizer	+0.1043	+0.0159	+0.0014	-0.5949
<input type="checkbox"/> Wing	+1.3559	+0.0900	+0.0144	-3.3096
Total	+0.1226	+0.0000	+0.0045	-0.0202

NEW



VOLUME SECTIONS: NEAR-WALL PRISM LAYER CELLS

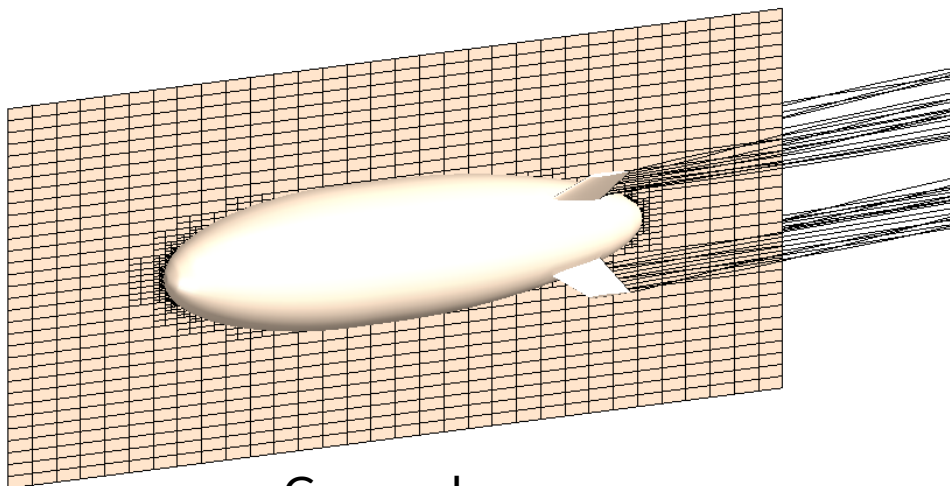
- Volume sections now have the ability to model near-wall prism layers.
- Enables clean visualization of the boundary layer velocity profiles.
- Sections can be built with just near-wall prisms, regular structured core regions or a combination of the two.
- Ability to specify number of layers within the near-wall region, growth rate of the layer thickness above the wall and the thickness of the near-wall region.



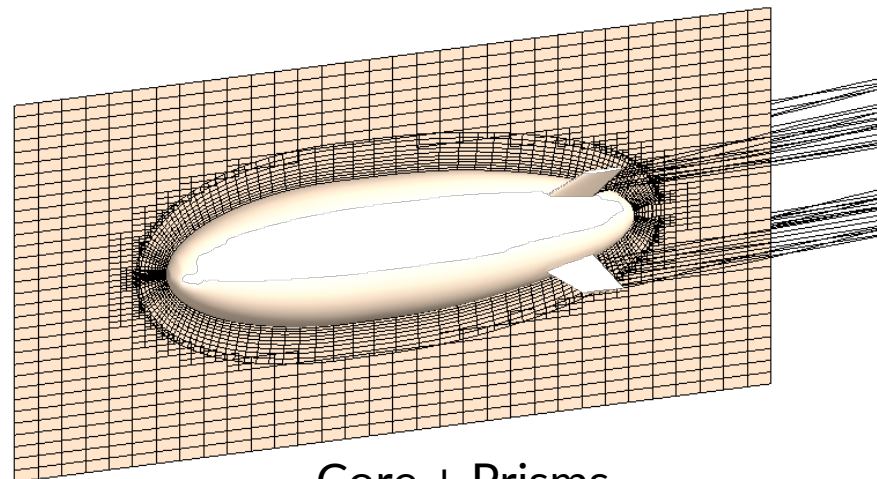
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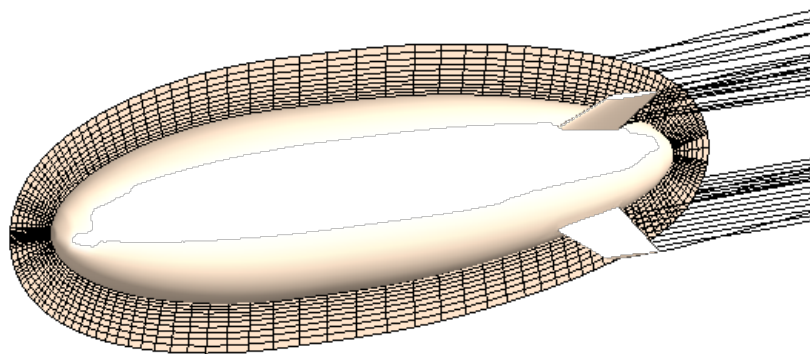
VOLUME SECTIONS: NEAR-WALL PRISM LAYER CELLS



Core only



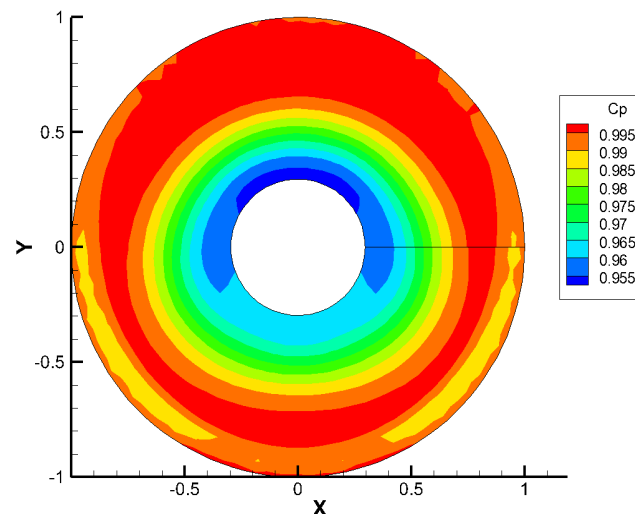
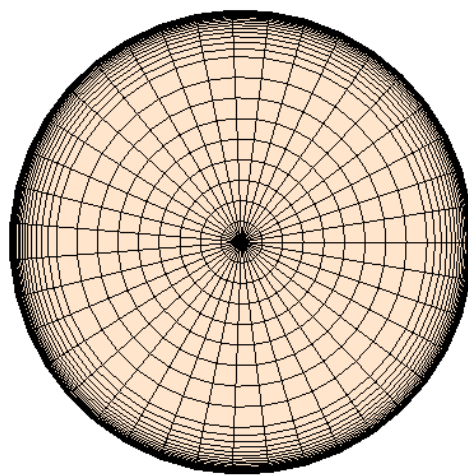
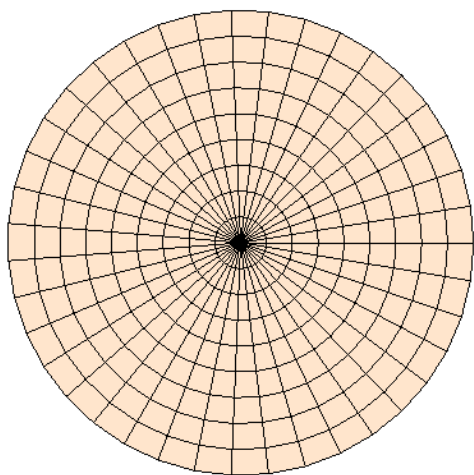
Core + Prisms



Prisms only

VOLUME SECTIONS: CIRCULAR & ANNULAR SECTIONS

- Users can now create special circular or annular analysis volume sections in addition to the existing rectangular volume sections.
- This feature enables clean structured annular sections near propulsion inlets/exhausts to capture the viscous interaction effects.
- Circular/annular volume sections are also equipped with near-wall prism layer growth regions.
- Viscous velocity plots can be exported from FlightStream on these sections for custom post-processing in Paraview, Tecplot or directly read into Matlab/Python codes for post-processing.

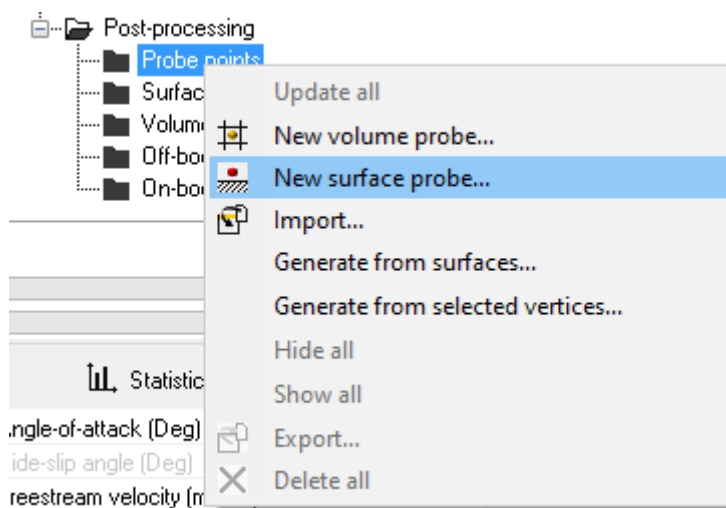


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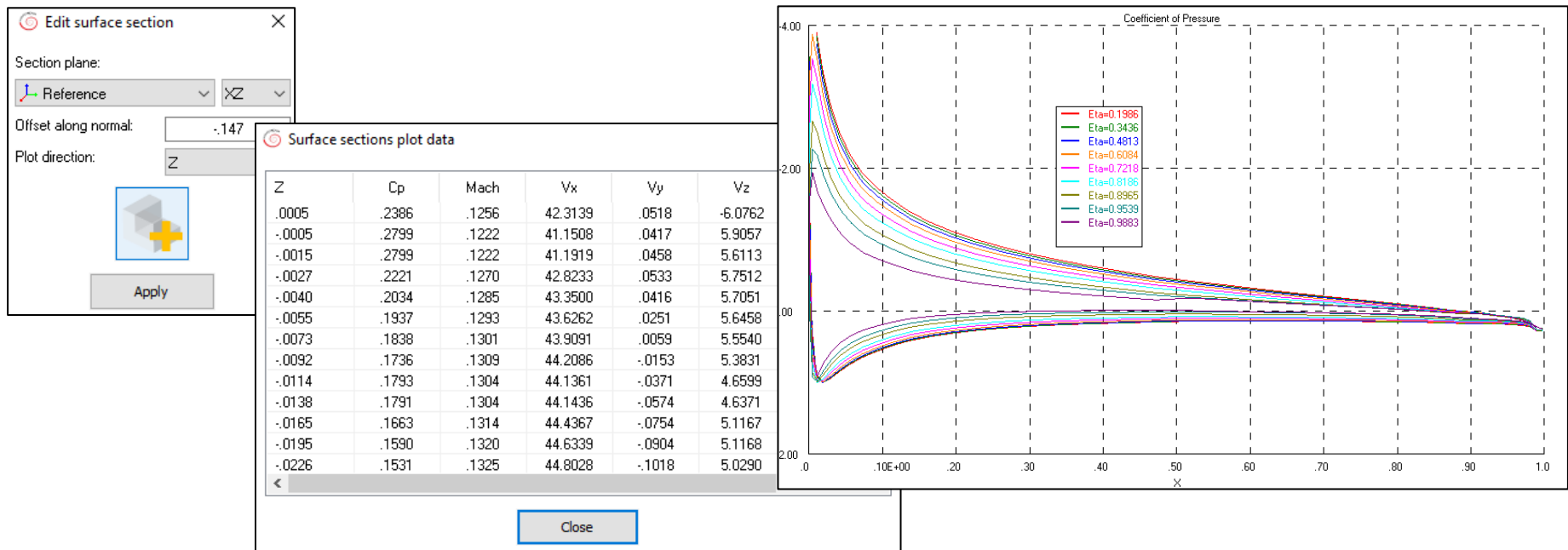
PROBE POINTS: SURFACE/VOLUME TYPES

- New probe point feature includes ability to specify as surface or volume probe.
- Enables surface probes to extract direct surface data from FlightStream solutions far more accurately than via the near-field volume approximation method of older versions of the software.
- Surface probes automatically interpolate on surface pressure field data in FlightStream.
- Very useful for extracting interpolated surface pressure data for structural analysis and FEA.
- Can be scripted and automated via import/export functions in FlightStream



SURFACE SECTIONS: BOUNDARY SELECTION & AUTOMATIC SORTING

- New surface section features allow users to specify individual or groups of boundaries to be used within the surface section.
- Enables users to split surface sections for individual components.
- FlightStream now also automatically sorts the unstructured surface mesh data for a surface section and generates cleanly plotted curves for easy analysis.
- Data can also be easily tabulated in spreadsheet mode in FlightStream and then copy/pasted to Excel or other sheet editors. Reduces user workload with file import/export.





NEW



MSC NASTRAN FILE FORMAT EXPORT: PLOAD BDF FILES

- New file export option from the Analysis tab in FlightStream.
- MSC Nastran pressure load (PLOAD) file format (*.bdf) can now be exported directly from FlightStream.
- Enables the transfer of surface pressure data from FlightStream to FEA with the click of a button.



NEW



ENHANCED USER INTERFACE, EASE-OF-USE FEATURES

- New copy/paste features for actuators, boundaries, coordinate systems, volume and surface sections.
- New group-selecting for sim-tree nodes using keyboard buttons.
- New copy/paste features for transferring data from FlightStream spreadsheets to Excel and other Windows OS spreadsheet editors.
- New ability to suppress GUI from command line during fully-automated solver runs.
- New Tabulate functions to generate spreadsheet for plotted data.

FLIGHTSTREAM[®] SCRIPTING

- FlightStream[®] is completely scriptable in a command line format
- Users can execute a scripted FlightStream[®] run with a specified simulation settings and geometry file.
- FlightStream[®] scripting is text-file based
 - Simply create the script in text format and use it in the command line call to FlightStream[®]!
- Extensive API library
- Highly suited for integration into an optimization pipeline such as one created in Modelcenter.





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THANK YOU