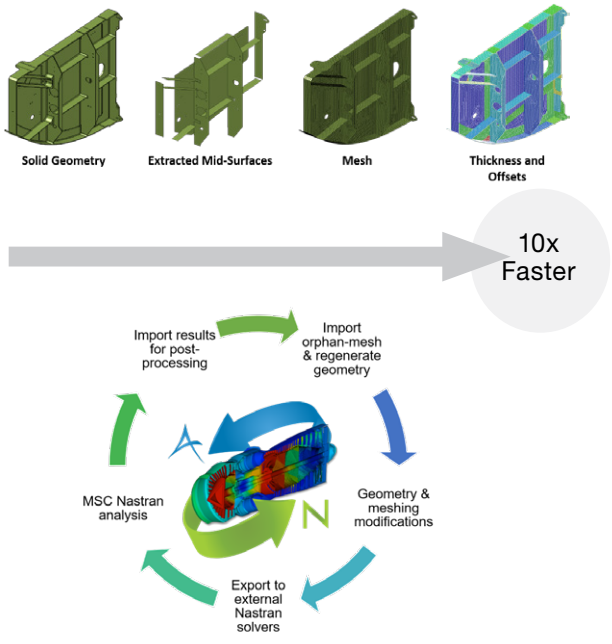
# MSC Apex™ | Modeler

## Direct Modeling & Meshing Solution

## Overview

MSC Apex Modeler is a CAE specific direct modeling and meshing solution that streamlines CAD clean-up, pre-processing (including intelligent geometry modification, one-shot meshing, and automation, etc.) and post-processing workflow. The solution features sophisticated and interactive tools that provide a new and innovative user experience, which helps to improve your daily productivity up to 10x.

- **Smart Tools -** With the embedded Direct Modeling technology, users can create and edit geometry interactively. Just select the entities of interest, such as a face, edge or vertex, and push, pull, or drag to implement any modifications. The mesh will update automatically with geometry modifications, without extra efforts. As a result, the number of tools required is usually 1/10 of that by using traditional software.
- **One-shot Meshing -** The high-performance meshing algorithms of Apex are generative and intelligent. Complex solids can be hex meshed by splitting them into hex-meshable cells and suppressing optional edges automatically. Powerful diagnostics tool of meshability can highlight unmeshable elements. Plus, a set of functions, such as face splits, mesh seeds, and outer face meshes, provide a guide to edit mesh. All of the above features are aiming at achieving one-shot mesh and requiring further operations as less as possible.
- **Intelligent Workflows -** Apex continuously incorporates useful workflows into Modeler. The most typical ones are incremental mid-surface workflow and Apex-MSC Nastran-Apex workflow. The incremental mid-surfacing plays as an efficient yet powerful tool to extract mid-surfaces from solids with complex geometry and varying thickness. Also, the interaction between Apex and MSC Nastran allow users to combine the generative modeling capacity of Apex with the analysis power of MSC Nastran, the most trusted multidisciplinary FEA solver in the world, to deliver accurate results with up to 1-x the productivity enhancement in pre/post-processing.
- **Easy to Use, Easy to Learn -** Apex is designed to have multi-purpose tools to make the application easy to use. It also features numerous learning aids such as tutorials, video-based documentation, workflow and at-cursor instructions which allow users at all levels to become productive in the short term without costly traditional training.



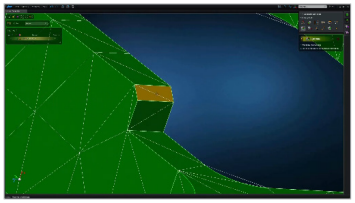

## Capabilities

- Edit Geometry Interactively
  - Identify features and de-feature by one click
  - Automate annoying geometry cleanup process
  - Split, fill, stitch and extend surfaces
  - Suppress/Unsuppress vertices or edges by mouse selection
  - Interactively edit solids, surfaces and features with intuitive Push/Pull or Vertex/Edge drag tools
  - Slicing, mirroring and Boolean geometry operations
  - Revolve/Extrude/Sweep/Loft to generate high-order geometries
  - Extract geometry from mesh directly
- Create and Repair Midsurfaces Intelligently
  - Extract mid-surfaces by auto offset, constant thickness, distance offset, or tapered methods
  - Incrementally build mid-surfaces of uniform or non-uniform thickness for planar or curved solids
  - Connect surfaces via direct modeling (Vertex/ Edge Drag), and auto Surface Extend or Stitching
- Generate and Edit Mesh with One-shot
  - Mesh curves, surfaces, and solids, available element types: Beam, Tri, Quad, Tet, Hex
  - Update the mesh automatically as geometry is modified
  - Refine mesh with Feature Base Meshing and Mesh Seeding
  - Inspect element quality visually and quantitatively
  - Deploy Seed Points to facilitate part connection
  - Mesh surfaces via paver, four side map, or 4+ side map mesh methods
  - Display, reverse or auto align element normal
  - Mesh solid geometry with hex elements using the multi-cut, multi-sweep approach
  - Provide Edge Tie functionality
- Attribute Model
  - Define composite plies
  - Material Creation and Assignment
  - Automatic creation of thickness and offset properties for uniform and non-uniform cross sections
  - Interactively position and orient beam spans
  - Define beam cross sections for standard shapes
  - Represent point masses
- Simulate Various Connectors
  - Display unconnected parts in Mesh Topology mode
  - Connect structural components via Glue
  - Simulate common connection types: springs, joints dampers, spring-dampers, bushing, discrete ties (RBEx)
  - Create generative mesh-dependent connections across parts, such as aligning nodes and rigidly tying nodes
  - Designate Local/Global coordinate system
- Automation Scripting Capability
  - Access built-in customer tool development environment in Apex GUI
  - Provide a robust API to support model building functionality
  - Automate model verification as an embedded standard in workflow, removing the likelihood of human errors
  - Allow users to automate repeated analysis tasks by using scripting APIs
- Learn and Use as an Expert Instantly
  - Enjoy stylish interface, intuitive icons, and adaptive screen resolutions
  - Learn with embedded tutorials videos, at-cursor instructions, and Google-style help searching tool without participating in hands-on training
  - Use the application in any of 5 supported languages: Chinese, English, French, German, and Japanese
  - Multiple Undo/Redo actions
  - Submit application enhancement ideas or issues with the Integrated Reporting Tool

# Direct Modeling and Meshing Workflow

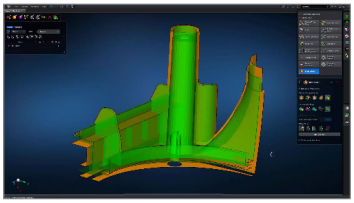
## 1 Remove Numerous & Unnecessary Features

Specify feature type, i.e., fillets, chamfers, holes, cylinders, etc., define feature dimension ranges, and automatically remove targeted features from the model.



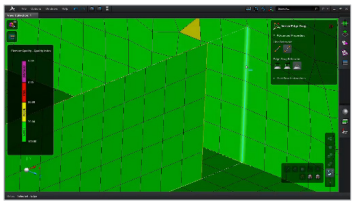
## 2 Extract Mid-Surfaces Interactively

Automatically or manually perform mid-surface extraction, options included: auto offset, constant thickness, and distance offset.



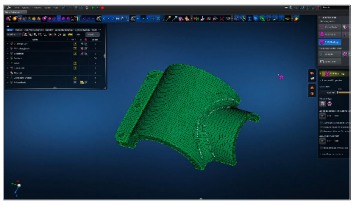
## 3 Repair Geometry with Direct Modeling Technology

Select an edge or vertex and interactively drag it to the desired location. Guidelines give you a preview of the action being performed.



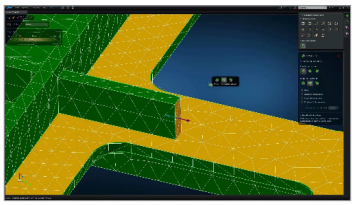
## 4 One-shot Mesh and Review Mesh Quality

Mesh models based on mesh size, element type, mesh seed and feature.



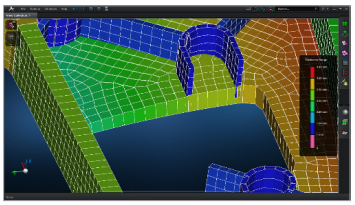
## 5 Simple Repair if Necessary and Re-mesh Automatically

Use direct modeling to further repair geometry that may already be meshed. Slivers or cracks may easily be resolved, and the mesh can be quickly regenerated automatically.

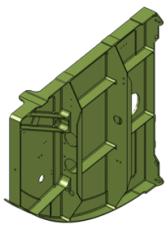


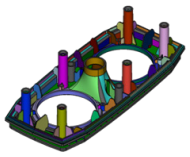
## 6 Automatically Create Thickness and Offset Assignments

Use Auto Thickness and Offset to create numerous property definitions for shell elements, and export to the BDF file format.



# Benchmarks

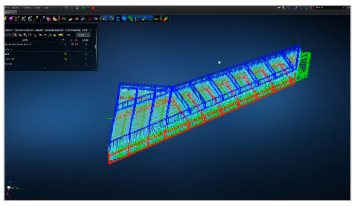
| Bulkhead of Fuselage | Time Spent | Today's Workflow | MSC Apex Workflow |
|---|---|---|---|
|  | Expertise Required | High | Low |
| | Analysis Geometry | 35 hrs | 3 hrs |
| | Mesh Creation | 3 hrs | 2 hrs |
| | Property Assignments | 12 hrs | 0.5 hr |
| | **Complete Entire Scenario** | **50 hrs** | **5.5 hrs** |

| Injection-Molded Plastic Part | Time Spent | Current Workflow | MSC Apex Workflow |
|---|---|---|---|
|  | Expertise Required | High | Low-Medium |
| | Analysis Geometry | 7 hrs | 0.75 hr |
| | Mesh Creation | 2 hrs | 0.17 hr |
| | Property Assignment | 1 hr | 0.08 hr |
| | **Complete Entire Scenario** | **10 hrs** | **1 hr** |

# Apex-Nastran-Apex Workflow

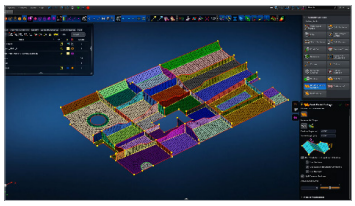
## 1 Import Nastran BDF Files

Import legacy Finite Element Models files (for example, MSC Nastran BDF files) into Apex, with automatic clean-up. Apex is capable of importing large assembly structures.



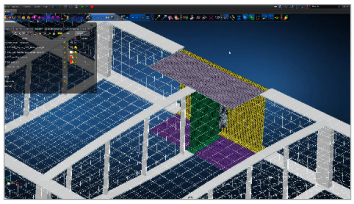
## 2 Regenerate Geometry from Mesh Directly

Re-generate geometry directly from mesh using Facetted Surface Tool, which is a significant step of Apex's unique support of "orphan-mesh workflow."



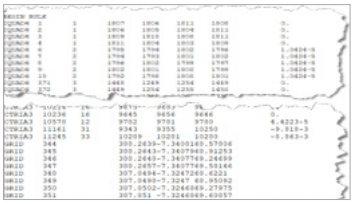
## 3 Add/Modify Geometry As Needed

Add CAD part or modify geometry with generative and intelligent geometry edition tools. Mesh will be updated automatically with geometry modifications.



## 4 Export BDF Files for External MSC Nastran Analysis

Export model into MSC Nastran BDF files. Users can also edit BDF files directly.

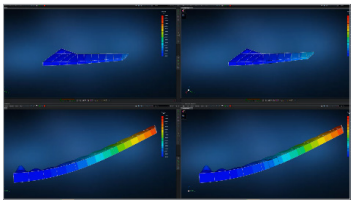


## 5 External MSC Nastran Analysis

Perform analysis with external MSC Nastran solver, combining the power of most trusted FEA solver in the world to deliver accurate results.


## 6 Import HDF5 Files Back for Post-Processing

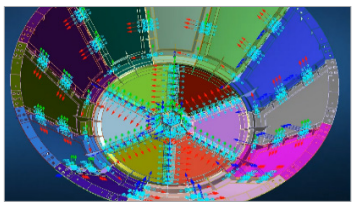
Import HDF5 files back to Apex for post-processing by using powerful result exploration tools.



# Automation Scripting Tools

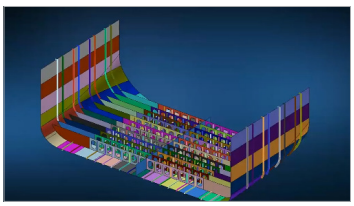
## Efficient Standard Parts Generation

Support Python3 and enhanced Application Programming Interface (APIs) for standard parts generation.



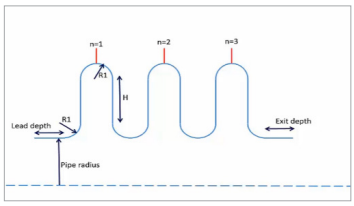
## Mature Model Building Functions

Provide mature functions to generate a full geometry model, especially useful in repeated structures and large assemblies modeling.



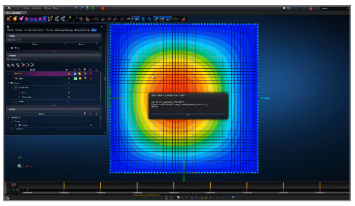
## Improved Customization Tools

Allow users to have enough freedom to customize their automation scripts depending on different missions.




## Enhanced Analysis and Result Exploration Capacity

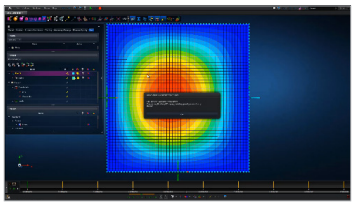
Users can use scripting to finish a typical FE analysis project, starting from geometry generation, structure meshing and post-processing in Apex.



# Powerful Meshing Capacity

## 1 Accurate Hex Meshing

Users now have more control tools to set mesh control points, which is useful for meshing irregular areas, for example, fillets.

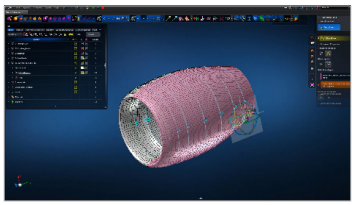


## 2 Feature-Based Meshing

Intuitive feature setting parameters are provided to control mesh generation at corresponding regions.

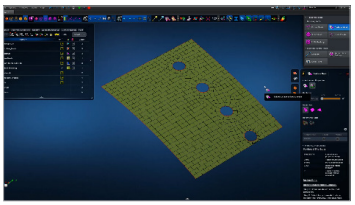
## 3 Generative Edge Tie Function

The smart edge tie function helps users to generate connectivity at free edges of components by a click, from which further high-order geometry generation can benefit.



## 4 Incremental Surface Meshing Capacity

To create a high-quality mesh, Apex allows users to pinpoint some specific areas or features to create local optimal mesh at first; then the global optimal mesh can be created quickly.





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