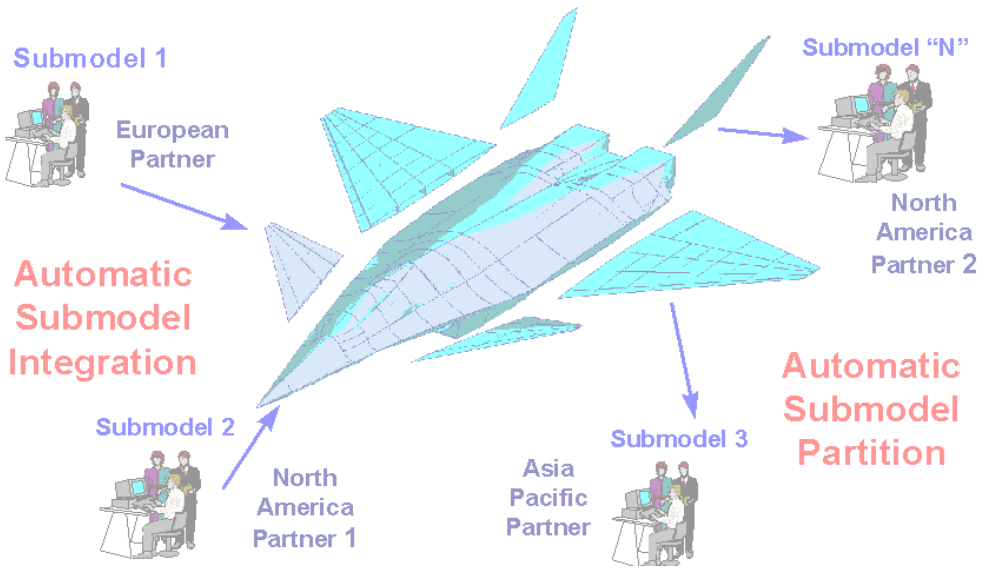
MSC/SuperModel

A CAE Data Management
and
Advanced Structural Modeling System

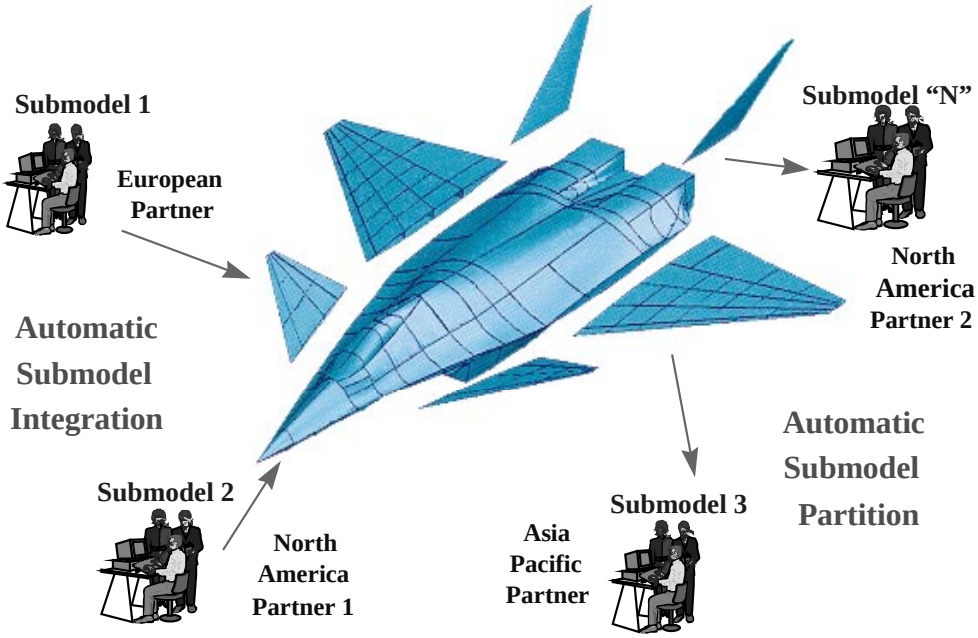


1.0 ABSTRACT

MSC/SuperModel supports the processes typically used in the design of large structures comprised of multiple components, typical of aircraft, jet engines, satellites, and launch vehicles. The engineering design and analysis of these large assembly structures is often conducted at the component level with multiple project engineers or project teams each responsible for a given component. In addition to modeling and simulating the performance of each individual component, the assembled vehicle performance must be verified as well. MSC/SuperModel provides an integrated engineering environment that greatly facilities the coordination and communication of engineering modeling and analysis results data among the project team(s). MSC/SuperModel is a powerful CAE process and data management system with engineering tools for advanced modeling and simulation.

Benefits

MSC/SuperModel supports significant productivity gains by enabling simultaneous modeling and simulation of large structures by any number of engineers working in parallel. Project engineers or teams are more efficient in their daily modeling and simulation activities through an integrated engineering environment where important data such geometry, materials, loads and component interface control points are readily available. The tedious, time consuming responsibility of managing project engineering data is simplified through the CAE data management capabilities of MSC/SuperModel. Easy-to-use modeling and simulation tools help engineers represent complex structures and understand the external environment within which their structure operates. Advanced analysis results tools help engineers more readily understand structural responses such as internal loads and dynamics.



MSC/SuperModel has advanced the state-of-the-art of commercially available CAE technology for large structural modeling and simulation. Current development is driven both by general industry and customer-specific requirements. MSC/SuperModel includes significant features and capabilities in

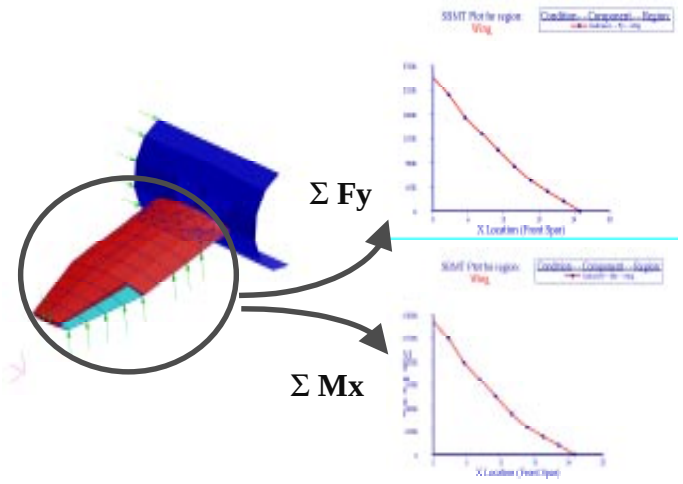
- Modeling and Simulation
- Assembly and Configuration
- CAE Data Management

2.0 MODELING AND SIMULATION

MSC/SuperModel offers a suite of modeling and simulation tools, in addition to the already robust set within MSC/PATRAN, that aid in the representation, analysis and results visualization of large, complex structures. Customer-developed applications are easily integrated with the standard set of tools delivered with MSC/SuperModel.

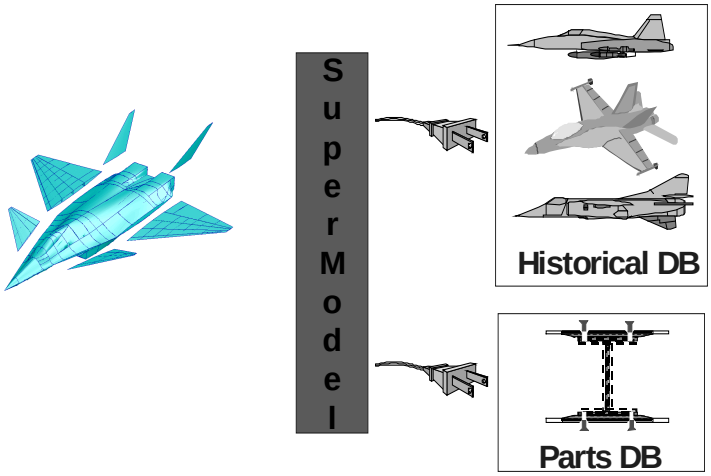
2.1 Running Load Plots

Engineers must understand the external loading environment within which their structure operates. This tool allows engineers to gain a better understanding of the operating environment through visualization of external loads such as shear, bending, moment and torque. Running Load Plots presents a summation of applied loads for a structure at a series of stations along one or more identified axes. Not only is this tool useful for checking applied loads and for preliminary structural sizing but is also useful as a good visual presentation of loads for management reviews.



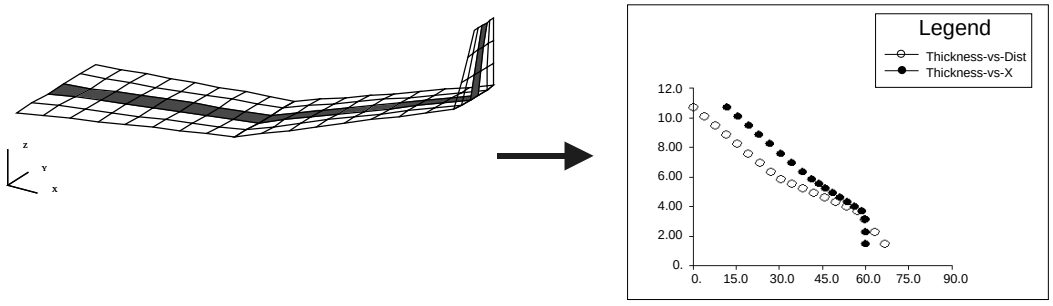
2.2 Mass Property Management

The Mass Property Management tool allows you to adjust the idealized structural model to more accurately represent operating weight configurations. This is desirable both for providing early weight estimates and to produce more accurate inertia loads and dynamic analysis. Customers may integrate proprietary historical weight databases through a well-documented programmatic interface. The finite element model information is used for the calculation of mass factors thereby eliminating the need for you to extract or redefine this information. MSC/SuperModel supports up to three unique mass factor adjustments as well as an overall adjustment (or Schmidt) factor.



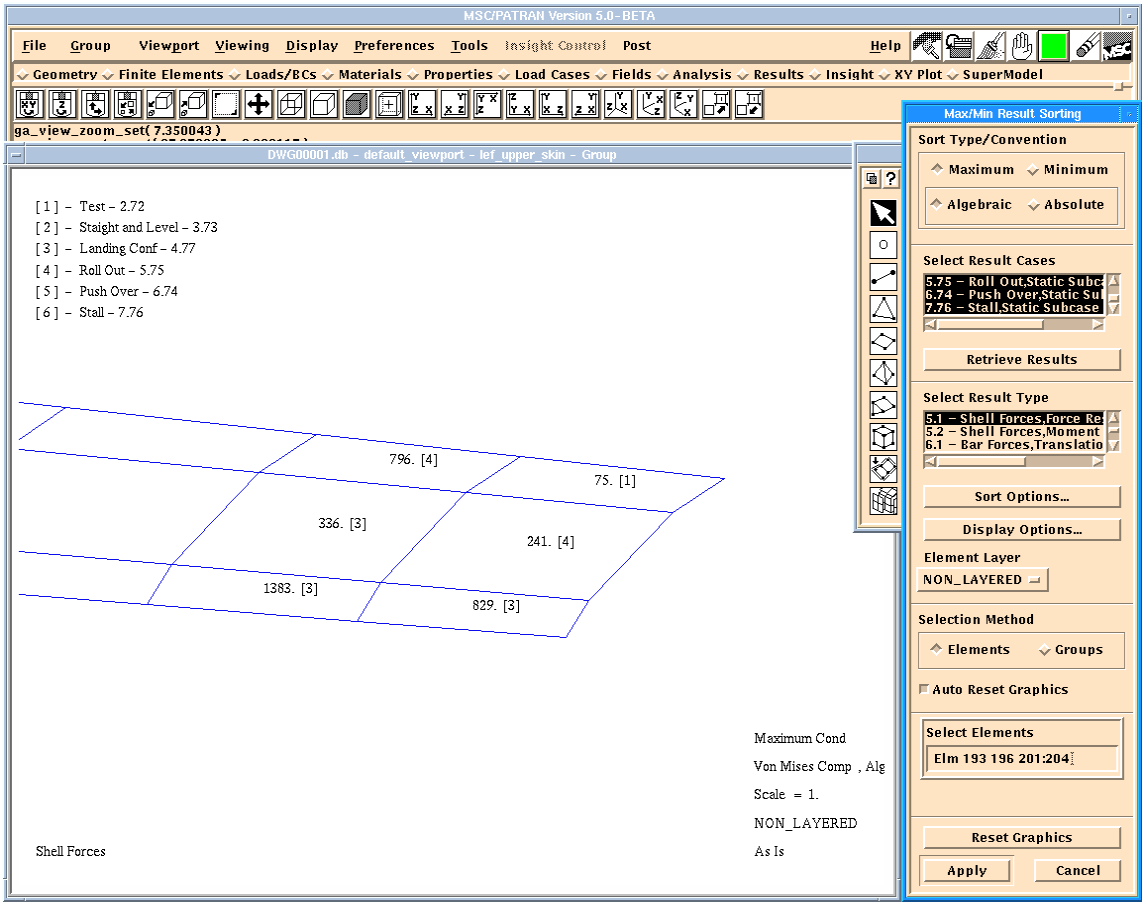
2.3 Property Data Plots

Property Data Plots is a tool for verifying, through XY plots, physical property modeling. Plots of structural properties such as sheet thickness and bar areas versus spatial location are a quick means of ensuring that properties have been properly assigned. When compared with running loads plots, they also provide a good check on component sizing.



2.4 Results Max/Min Plots

Max/Min Plots allows you to examine multiple result cases from not only different load conditions but also different structural configurations and determine those which will most influence a structure's design. The full range of result quantities is supported including any scalar, vector or tensor. Independent display controls and automatic report generation are included. Most importantly, for any analyzed load condition, MSC/SuperModel will plot the maximum or minimum load value for each element and display the associated load condition.



2.5 Bar and Spring Force/Moment Plots

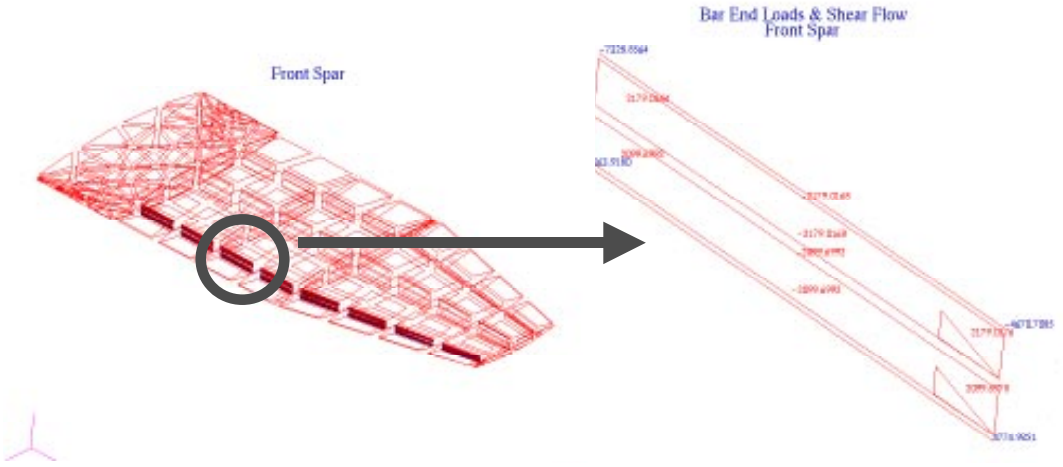
The Bar and Spring Force/Moment Plots tool is used to visualize internal loads within bar and spring representations. The display is easily customized for selected force and moment components. A report file can be automatically generated.

2.6 Shear Panel Plots

The Shear Panel Plots tool is used to visualize internal shear flow within shear panel representations. The display is easily customized for either averaged or edge shear flow representations. A report file can be automatically generated.

2.7 Bar End Loads Plots

Bar End Loads provides a means of determining the load transfer occurring between the shear carrying panels and the attached axially loaded stiffening members. This derived information is typically required in the generation of stress reports. A report file can be automatically generated.



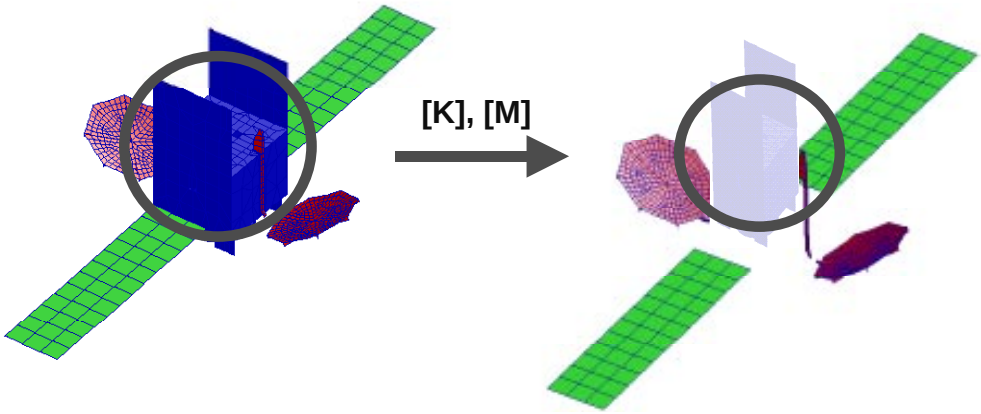
3.0 ASSEMBLY AND CONFIGURATION

MSC/SuperModel allows engineers to model and analyze large structures as an assembly of components. The ability of MSC/SuperModel to assemble component models in an automated procedure allows project teams to more easily manage structural modeling tasks. MSC/SuperModel allows engineers to analyze multiple structural configurations as defined on a single model.

3.1 Reduced Stiffness and Mass Modeling

The Reduced Stiffness and Mass Modeling tool is useful for component simplification. By describing unvarying structural component models as their boundary stiffness and mass effects, analysis time is reduced while maintaining proper structural responses. These reduced representations replace their physical structure and can be used in analyses involving multiple structural configurations. During a structural design study where, for example, different materials are being studied, only the variable structural models are

required to be present; all other components can be described using reduced stiffness and mass models.

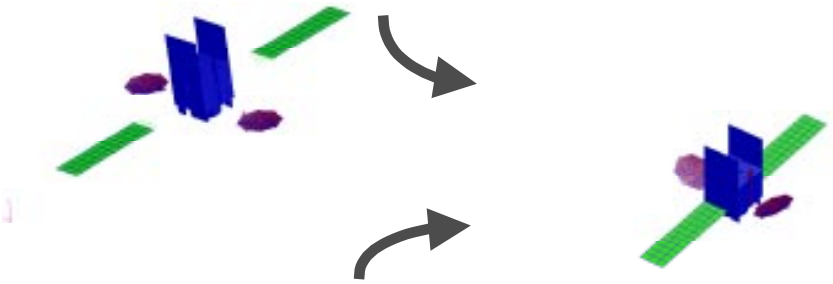


MSC/SuperModel will automatically store the reduced stiffness and mass models in the File Manager hierarchy and maintain an association to the originating structural components (see below for more details).

3.2 Assembly of Components

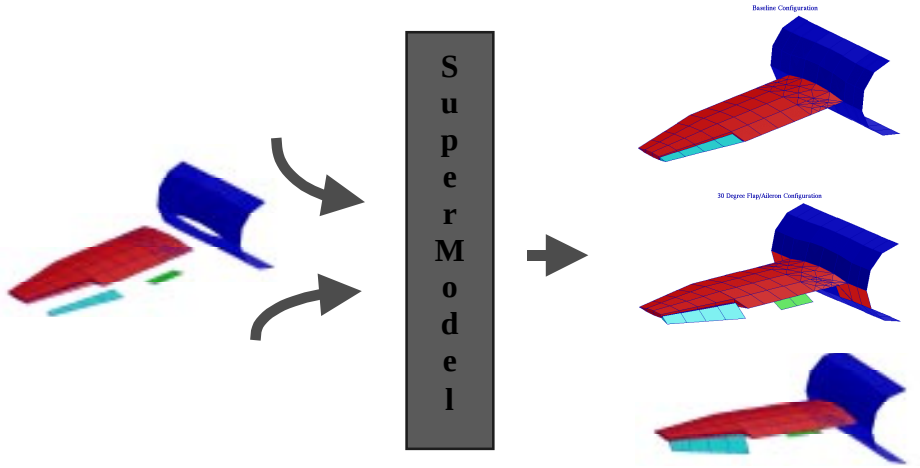
The division of labor is a common technique used to reduce a large problem into a set of smaller, manageable pieces. MSC/SuperModel is designed to support the discretization of large structural models into a series of component models. These components, or Submodels, are defined in MSC/SuperModel as individual finite-element models that represent portions of the overall model. Typically, these components consist of finite-elements and their associated properties, loads, boundary conditions, and materials. As an example of component modeling, consider that the wing of an aircraft consists of a leading-edge flap, transmissions, torque boxes, and ailerons. Each of these sub-assemblies are may be considered as a separate Submodel within MSC/SuperModel.

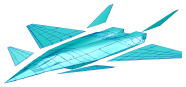
A collection of Submodels can then be merged into a global model for subsequent analysis. Extensive logic exists within MSC/SuperModel for automated management of common materials, properties, loads and boundary conditions.



3.3 Configurations

A structural model may assume different configurations throughout its operating envelope. MSC/SuperModel allows you to model different structural configurations and perform analyses on these with the push of a single button. All named configurations may be associated with unique load configurations. Upon completion of the analyses, results from each unique configuration may be easily compared using, for example, the Max/Min Results tool under Modeling and Simulation.





3.4 Analysis of Assembled Structure

MSC/SuperModel automatically handles the assembly and analysis of a global structural model. Upon completion of the analyses, the results are automatically returned to the newly created SuperModel for subsequent postprocessing.

The assembly and analysis of global structure is recorded in a Job Definition. A Job Definition is automatically maintained by the File Manager within MSC/SuperModel and is associated with the assembled global structure. The selected components, configurations, load conditions and results requests are all maintained for future reference. Trade studies are easily performed through structural changes at the component-level model and subsequent reanalysis through execution of an existing, named Job Definition. The structural responses of the newly created SuperModel may be compared to those previously created.

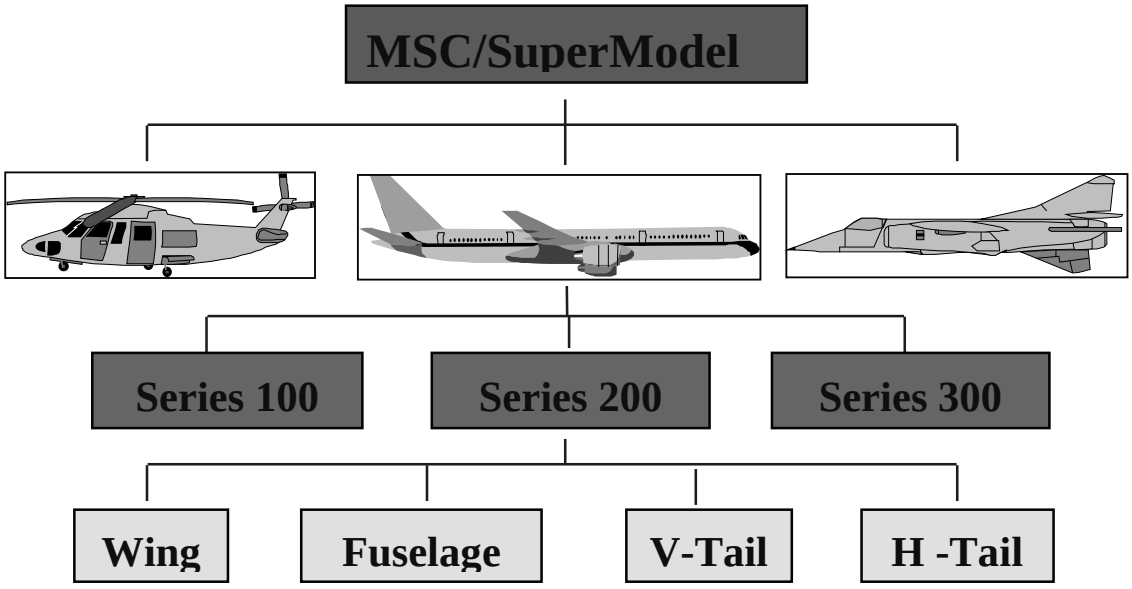
The assembly and analysis procedure may be performed in “batch” mode, thus allowing you to continue with other modeling and simulation activities. Analysis jobs are easily monitored using the Analysis Manager, integral to MSC/SuperModel.

4.0 CAE DATA MANAGEMENT

MSC/SuperModel can help engineers manage their CAE data. The File Manager module within MSC/SuperModel is a flexible, client-server system that enables the management of the large numbers of files associated with component modeling through an organized file hierarchy with flexible file naming. This hierarchy is user-defined with up to ten levels; one example would be an organization based on *project, configuration, component, team*, etc. The File Manager serves as the interface between MSC/SuperModel and the computer file system used to store engineering data. The File Manager uses intuitive commands, such as *rename, compress, copy, list*, or *transfer*, in place of the computer system equivalent commands. Users are relieved of the burden of knowing UNIX file locations; rather, they may locate their data in a natural, hierarchical system. MSC/SuperModel system administration tools allow key users additional access to the system. Custom operation may be included before and after typical file operations such as Open, Close, Save, Save As and Quit.

4.1 Hierarchy

MSC/SuperModel supports a customized, multi-level hierarchy for the management of CAE data. This data can be organized by discipline, product, project, configuration, etc.



Information is stored within this hierarchy using the concept of logical files. A logical file is a collection of physical files, all related to a specific component model. File operations such as move/copy are performed on the logical files.

4.2 Integrated Engineering Environment

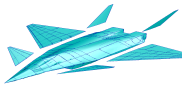
MSC/SuperModel supports an integrated working environment where engineers share common product/project data such as geometry, materials, and component interface points. This information can be shared at the global hierarchy level, specific branch level, or at each sub-component level.

4.3 Data Access Control

Data integrity is maintained through restricted data access. Hierarchy data access can be restricted at the individual user level. Only one user is granted write access at a time, while multiple users have read access. Files throughout the hierarchy can be locked for released project data.

4.4 Automatic History Tracking

Each logical entry within MSC/SuperModel has an associated history file. All file operations are automatically recorded, along with date, time and user information. Users may add their own comments to the history file.



4.5 Comprehensive Suite of Data Management Tools

MSC/SuperModel contains a number of CAE data management tools. In addition to those discussed above, the following options are also available.

- Data may be communicated to and from the File Manager, including with PDM systems.
- Automatic data compression.
- Data locking.
- Move/Copy.
- File-type filtering.
- Automatic recognition of file states. For example, compressed files are automatically uncompressed upon access.
- Hierarchy contents report.
- Support of multiple, heterogeneous servers and computer systems.

5.0 Summary

MSC/SuperModel provides significant productivity gains compared to conventional methods by enabling simultaneous modeling and simulation of complex structures by any number of engineers working in parallel. Easy-to-use tools are provided to help engineers understand better the nature of the modeled structure, as well as the operating environment. Robust tools are used to easily assemble components into global structures, quite possibly with multiply defined configurations. Trade studies are easily performed through automated analysis techniques. Engineers are relieved of the burden of managing their engineering data. MSC/SuperModel allows engineering companies to focus on their core business and be more competitive.