Add-On Module

11.0 RELEASE

ANSYS® DesignModeler™

Modeling and Geometry Editing Tailored for Simulation

Creating design models is a core part of the product development process and the first step in the simulation process. These models can be of a geometry form representing the actual design detail, or they can be an approximation of the design using simplified components like beams and plates.

Simulation often demands unique modeling capabilities that typical computer-aided design (CAD) operations do not require. Therefore, these capabilities are either lacking in CAD systems or implemented in a fashion that is not optimum for performing simulation-related functions.

The ANSYS DesignModeler product is an ANSYS® Workbench™ application that provides modeling functions unique for simulation that include detailed geometry creation, CAD geometry modification and concept model creation tools.

Detailed Geometry Creation

ANSYS DesignModeler offers geometry creation features such as extrude, revolve, sweep, chamfer functions and others to create fully parametric models. These models can be used with any core ANSYS simulation product or with the ANSYS® DesignXplorer™ product for performing design optimization.

CAD Geometry Modification

CAD models are usually intended to accurately represent the exact intent of the final design and often lack additional features required for simulation. The DesignModeler product provides these unique simulation features, such as splitting surfaces for applying loads, defining welds or creating regions around models that represent “air.”

CAD models also may contain much more detail than the simulation process requires or the detail may not be in the right form. ANSYS DesignModeler software enables tasks like CAD feature deletion, surface extraction from a solid body, suppressing parts and merging parts into one body.

Concept Model Creation

Concept models are used in a product development process prior to any detailed CAD geometry being created. These design approximations, along with simulation results, are extremely useful in making fast product decisions early in the design cycle, when product costs can be impacted significantly.

Electromagnetics Modeling Tools

The majority of MCAD systems do not allow users to prepare a solid model for an electromagnetic analysis. The ANSYS DesignModeler product provides several essential tools for this process.

ANSYS DesignModeler Features

3-D Parametric Modeling

- Extrude
- Revolve
- Sweep
- Skin/loft
- Surface
- Blend
- Chamfer
- Welds

Primitive Shapes

- Sphere
- Box
- Parallel piped
- Cylinder
- Cone
- Prism
- Pyramid
- Torus
- Rectangular bend

Primitive Shapes

- Merge/slice bodies
- Surface extraction
- Surface extension
- Join surfaces
- Cone
- Volume enclosure
- Volume fill
- Face delete
- Named selection
- Symmetry extraction
- Mid-surfacing

3-D Concept Modeling

- Beams from lines/edge
- Plates from lines/sketches
- 11 cross section types
- Parametric cross sections

2-D Sketching

- Drawing tools
- Line modifications

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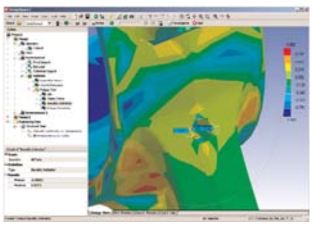
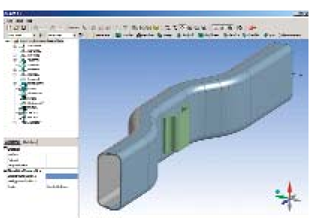
ANSYS Workbench

The ANSYS Workbench interface represents the next step in the continuing evolution of the ANSYS scalable solution. First introduced in ANSYS® DesignSpace® 6.0 software, this GUI offers users more intuitive simulation controls.

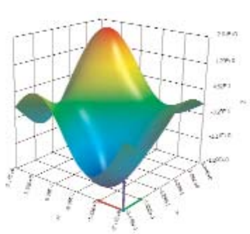
Fatigue: The ANSYS® Fatigue™ module adds the capability to simulate performance under anticipated cyclic loading conditions over a product's anticipated life span. Incorporating both stress life and strain life analyses with a variety of mean stress correction methods, including Morrow, Smith–Weston–Topper (SWT) and no mean effects, ANSYS Fatigue module provides contour plots of fatigue life, damage, factor of safety and stress biaxiality. Additional results include rainflow matrix, damage matrix, fatigue sensitivity and hysteresis.



ANSYS DesignModeler: This software aids in preparing CAD geometry for simulation. It provides users with a solution for implementing analysis-led design rather than CAD-led design.



ANSYS DesignXplorer: This module adds advanced parametric control to permit study of the simulation response to proposed modifications. The module includes the ability to quantify and graph results.



Enclosure Tool: This is used to enclose the bodies of a model in a dielectric material (typically air) required for an emag analysis. Full or partial models can be included in the enclosure, and symmetry is supported when the enclosure shape is a box or a cylinder. (Up to three symmetry planes can be specified.)

Winding Bodies: These represent wires or wound coils for electromagnetic source excitation. The advantage of these bodies is that they are not 3-D CAD objects and, hence, greatly simplify modeling and meshing of current carrying structures. Upon "attach to simulation," winding bodies are assigned as conductor bodies.

Winding Tool: This creates complex coils for motor windings. The winding tool uses a worksheet table format to drive the creation of multiple connected winding bodies. The winding tool also can import/export an Excel spreadsheet describing the coil.

Geometry Exchange

The ANSYS DesignModeler product can read geometry from any ANSYS Workbench supported CAD system. Parametrically supported CAD systems also will be parametrically associative in ANSYS DesignModeler. In addition to importing data, the ANSYS DesignModeler product also can export data as Parasolid®, IGES, STEP and the ANSYS ANF geometry format.

ANSYS® DesignXplorer™

The ANSYS DesignXplorer solution works from within the ANSYS Workbench interface to perform Design of Experiments (DOE) analyses of any ANSYS Workbench simulation, including those with CAD parameters. Although it requires more analyses to be performed and is typically slower than Variational Technology, which is also a part of ANSYS DesignXplorer, DOE is not limited in the types of analyses that can be used with it. In fact, ANSYS DesignXplorer software can be used with ANSYS® Parametric Design Language™ (APDL)-based files to perform DOE on existing or new ANSYS analyses. ANSYS DesignXplorer allows you to perform optimization and Design for Six Sigma with any application or sequence of applications, including in-house codes, by using the third-party plug-in.

ANSYS DesignXplorer has a powerful suite of DOE tools. Automatic Design Points can be generated two ways, Central Composite Design (CCD) or Optimal Space-Filling. CCD provides a traditional DOE sampling set, while Optimal Space-Filling's objective is to gain the maximum insight with the fewest number of points. After sampling, ANSYS DesignXplorer provides four different meta-models to represent the simulations responses; Full Second-Order Polynomial, Kriging, Non-Parametric Regression and Neural Network. Kriging has two variants, pure Kriging and Radial Basis Function. These meta-models can accurately represent highly nonlinear responses. Once you have the simulation's responses characterized, ANSYS DesignXplorer supplies three different types of optimization algorithms: Screening (shifted Hammersley), Multi-Objective Genetic Algorithm (MOGA) and Nonlinear Sequential Quadractic Programming (NLPQL). ANSYS DesignXplorer has a full suite of sampling, modeling and optimization routines to address a wide variety of applications.

Variational Technology

Look beyond traditional aspects of response simulation by using the Variational Technology method within ANSYS DesignXplorer that gives users a broader view of design concepts providing complete FEA results for every design point. Depending on the analysis problem, the Variational Technology method can provide acceleration factors up to 100. With Variational Technology (VT), users can approach product design decisions much more efficiently.

Using the VT method to automatically calculate the entire design envelope within a single finite element solution, ANSYS DesignXplorer software allows users to perform quick and accurate what-if scenarios to periodically test design ideas. A traditional Design of Experiments approach requires many solutions to capture the behavioral changes due to parameter variations. For boolean parameters, the practical limit using traditional methods is about 10 boolean parameters, but the VT method handles up to 20 boolean parameters.

The Variational Technology method addresses many kinds of parameters:

- Geometric variations (CAD or ANSYS DesignModeler)
- Boolean variations (active or inactive status of spot welds, stiffening ribs, bolts, etc.)
- Element property variations (shell thickness, spring stiffness, point mass)
- Material variations (engineered plastics, composites, metals)
- Load variations (inertia and surface structural and thermal loads)

ANSYS® Mechanical™ HPC

ANSYS Mechanical HPC brings together a wide variety of high-performance computing (HPC) solutions together, including ANSYS® VT Accelerator™ and parallel computing.

VT Accelerator: Variational Technology Applied to Solver Speedup

Variational Technology has been applied to two distinct types of mathematical problems: nonlinear solutions for structural and thermal analyses and harmonic analysis. These capabilities are referred to as VT Accelerator. VT Accelerator provides a 2X to 5X speedup for the initial solutions depending on the hardware, model and type of analysis. VT Accelerator makes re-solves 3X to 10X faster for parameter changes, allowing for effective simulation-driven parametric studies of nonlinear and transient analyses in a cost-effective manner. You can make the following types of changes to the model before a VT Accelerator re-solve:

- Modify, add or remove loads (constraints may not be changed, although their value may be modified)
- Change materials and material properties
- Change section data and real constants
- Change geometry, although the mesh connectivity must remain the same (that is, the mesh must be morphed)

VT Accelerator for Nonlinear Solution Speedup

VT Accelerator for nonlinear solutions speeds up the solution of applicable nonlinear analysis types by reducing the total number of iterations. VT Accelerator supplies an advanced predictor–corrector algorithm based on Variational Technology to reduce the overall number of iterations for nonlinear static and transient analyses. It is applicable to analyses that include large deflection, hyperelasticity, viscoelasticity and creep nonlinearities. Rate-independent plasticity and nonlinear contact analyses may not show any initial improvement in convergence rates; however, you may choose this option with these nonlinearities if you wish to resolve the analysis with changes to the input parameters. In general, VT Accelerator can be used for:

- Nonlinear structural static or transient analyses not involving contact or plasticity
- Nonlinear thermal static or transient analyses

Parallel Computing Features

Memory Architectures

Shared Memory
In a shared memory environment, a single shared memory address space is accessible by all processors. Therefore, each CPU shares the memory with the others. A common example of a shared memory system is a Windows® X64 machine with two cores. Both processors share the same main memory space through a common bus architecture.

Distributed Memory
In a distributed memory environment, each CPU or computing node has its own memory address space that is not shared by other CPUs or computing nodes. Communication between machines is by message passing interface (MPI) on the network. A common example of a distributed memory system is any collection of desktop workstations linked by a network. When the collection of linked processors is dedicated to being a compute engine and is not used for everyday tasks (such as email or browsing), it is called a cluster.

Mixed Memory
Mixed memory indicates that the cluster is using a combination of both shared and distributed memory. A common example of a mixed-memory system is a cluster of IA64 machines with two cores in each physical box sharing that memory, but with a number of these units connected to each other by a network. The PCG Lanczos, PCG, JCG and DSPARSE solvers all support both shared memory and distributed memory by treating the shared memory as if it were distributed memory.

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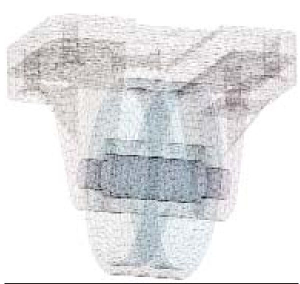
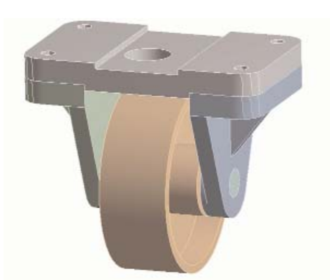
Product Features

Multi-Processing Computer Environments
- Windows® CCS
- Windows x64 clusters
- 64-bit Linux® clusters
- 32-bit Linux clusters
- UNIX® servers
- Networked workstations

Memory Architectures Supported
- Shared memory
- Distributed memory
- Mixed memory

Analysis Types Supported by Distributed ANSYS
- Static linear or nonlinear analyses
- Full transient structural analyses
- Static thermal analyses
- Full transient thermal analysis
- Magnetostatic, steady-state electric conduction and electrostatic analyses
- Time-harmonic and time-transient magnetic and electric analyses





Today it is quite common to go from CAD geometry to a finite element mesh. At ANSYS 11.0, within FE Modeler, a user can transform a mesh (top) into geometry (bottom) and then, with the ANSYS Mesh Morpher, make it parametric — thereby making design studies and optimization possible.

VT Accelerator for Harmonic Analysis

The harmonic sweep feature of VT Accelerator provides a high-performance solution for forced-frequency simulations in high-frequency electromagnetic problems and structural analysis. For a structural harmonic analysis, the material may have frequency-dependent elasticity or damping.

Distributed ANSYS: Parallel Power from Multi-Core to Clusters

Time is money! At ANSYS, we understand how much time means to you and that multi-processing is one means to reduce analysis time. Multi-processing computer environments (consisting of multi-processor servers or networked workstations or clusters) may be employed to generate simulation results much more quickly. The parallel portion of ANSYS Mechanical HPC facilitates this highly effective means of operation.

With Distributed ANSYS, part of the ANSYS Mechanical HPC module, the entire solution phase runs in parallel including the stiffness matrix generation, linear equation solving and results calculations. Because each of the three main parts of the overall solution are running in parallel, the wall clock time is significantly reduced. On distributed hardware, the memory required also is distributed over multiple systems. This memory-distribution method allows you to solve very large problems on a cluster of machines with limited memory. With multiple processors, you can see significant speedup in the time it takes to run your analysis for both linear and nonlinear analyses.

Revolutionary is the new Distributed PCG Lanczos solver, which allows for the quick extraction of eigenvalues and eigenmodes for very large models greater than 100 million degrees of freedom. In addition to the Distributed PCG Lanczos, Distributed ANSYS supports Distributed PCG and Distributed Sparse solvers. As always, Distributed ANSYS works equally well on both distributed memory and shared memory hardware.

Mesh Morphing

By working with a mesh and not the solid model, the ANSYS Mesh Morpher allows parameterization of models created from CAD data, nonparametric geometry data such as IGES or STEP, or mesh files such as the ANSYS .cdb file. Read a mesh into FE Modeler and then create an initial configuration to synthesize geometry from the existing mesh. At ANSYS 11.0, the ANSYS Mesh Morpher allows four different transformations: Face Translation, Face Offset, Edge Translation and Edge Offset. A wide variety of configurations can be created with these transformations. For example, a Face Offset of a cylindrical surface is equivalent to changing the radius. These translations determine target configurations and automatically define transformation parameters.

Drop Test

Product drop tests present users with unique parameters for simulation and analysis. The ANSYS® Drop Test™ module further enhances an ANSYS® LS-DYNA™ license by adding a complement of loads and conditions tailored specifically for such analyses.

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