SimWise for **A** alibre

3D Dynamic Motion, and Stress Analysis
integrated with Alibre Design

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Technologies
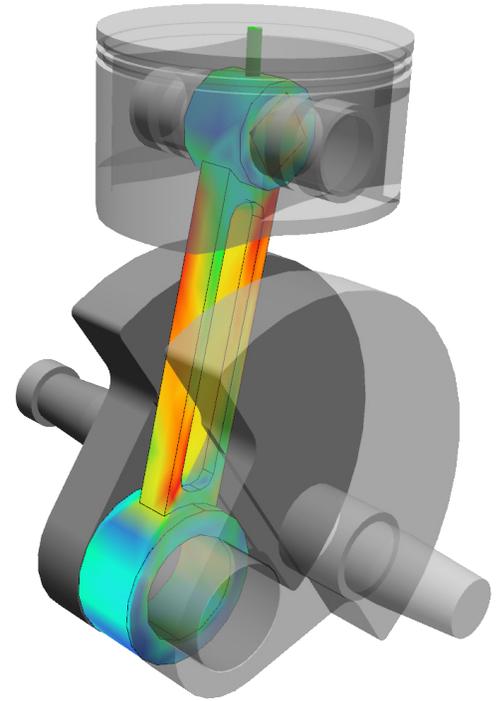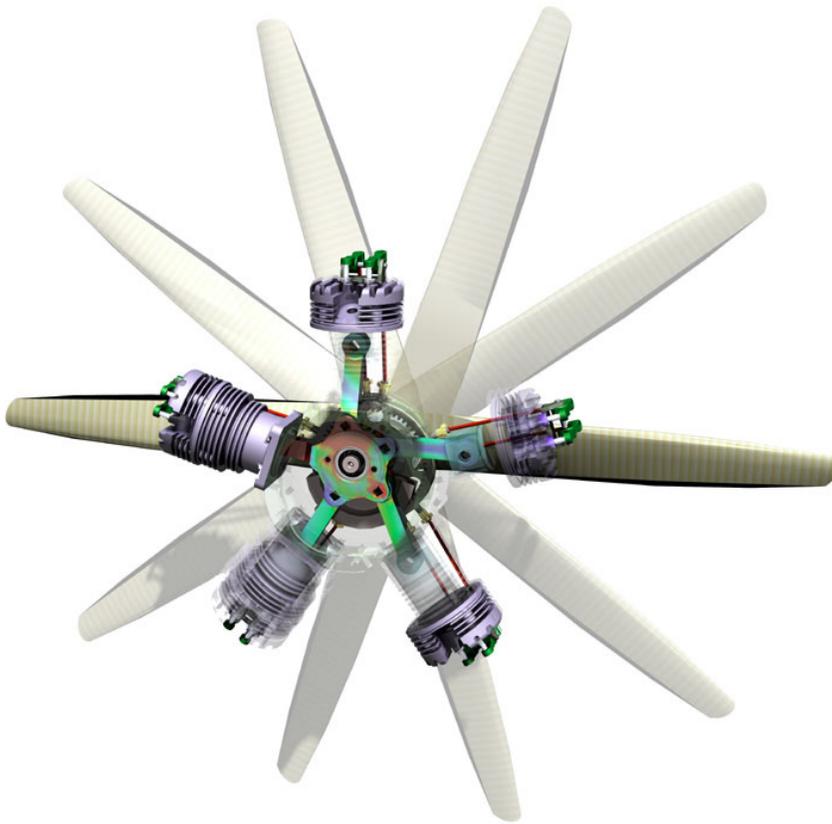
SimWise 4D for Alibre
Integrated Motion Simulation and Stress Analysis

SimWise 4D is a software tool that allows the functional performance of mechanical parts and assemblies to be simulated and validated. It combines 3D multi-body dynamic motion simulation with 3D finite element analysis in a Windows based product integrated with Alibre Design, priced affordably for every engineer. Each of the major components of SimWise 4D, the motion module, and the FEA module, is available as a

separate product and are powerful in their own right but the real benefits arise when the two are combined together in the 4D product.

Designs that are made up of moving mechanical parts present challenges when it comes time to answer fundamental questions like "Does it work?", "Will it break?", "How can it be designed better?", and "How long will it last?".

Dynamic forces are hard to calculate and the part stresses induced by motion are even more difficult to quantify. Many of these designs are validated in the test lab or in the field using prototypes of pre-production designs. If problems are found the designs must be revised and the process repeated, resulting in a costly and time-consuming approach to product validation

SimWise 4D gives you the ability to explore the functional performance of your design before prototypes are built. Options can be explored in a timely and cost effective manner because hardware does not need to be built until you have confidence that your design works as intended. The capabilities of SimWise 4D make "getting it right the first time" more than just a slogan; it makes it an integral part of your design process.
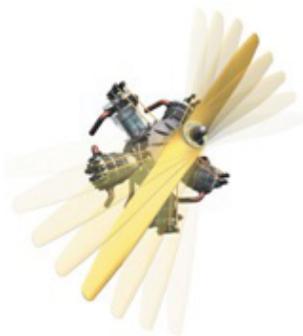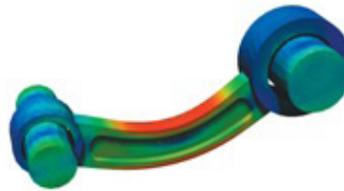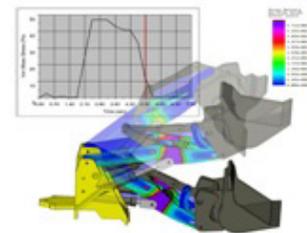
Motion + FEA = 4D

Integration with Alibre Design

All of the SimWise products are integrated with Alibre Design. Using an Alibre Design add-in developed specifically to transfer Alibre Design data to SimWise, geometry, mass properties, materials, and assembly constraints, can be transferred to SimWise with a single operation.

Assembly constraints are automatically mapped to SimWise joints. The SimWise model contains associative links back to the Alibre

Design model. If a change is made to the Alibre Design model a single operation will update the SimWise model to reflect those changes. The change process can be initiated from either SimWise of Alibre Design.

Annotation and Mark-up

Annotations in the form of text, call-outs, and distance and radial dimensions can be added to the simulation model. The distance dimensions are active in that they update if the model is moved or animated. SimWise also provides a distance dimension that shows the points of closest approach and the minimum distance between two bodies. This dimension also updates as the bodies move.

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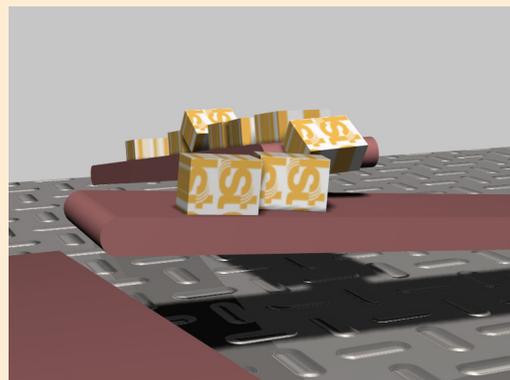
SimWise Motion for Alibre
3D Motion Simulation

SimWise Motion is rigid body kinematics and dynamics simulation software that lets your build and test functional virtual prototypes of your designs on the computer and simulate the full-motion behavior of those designs. It imports geometry, mass properties, and constraints from Alibre Design and allows you to add motion specific entities to the model resulting in a functional operating prototype of your design. It simulates that prototype using advanced physics and mathematical techniques and presents the results of the simulation in various graphic and numeric formats. You can quickly determine how your design operates and determine if it meets your design objectives or if modifications are necessary. All on the computer, all without costly and time-consuming physical prototypes.

SimWise Motion has a rich set of functional objects that are added to your Alibre Design model to build a functional operating prototype. These objects include:

► Rigid, revolute, spherical, curved slot, planar constraints

► Rods, ropes, springs, gears, belts, pulleys, conveyors

► Bushings (flexible connections)

► Motor and actuators

► Point forces, torques, distributed forces, pressure, friction forces

Collisions between parts are handled easily allowing the simulation of mechanisms like ratchets, clamps, grips, and others that rely on contact between two or more parts to operate. Contact forces and friction forces that occur at the time of contact are calculated and available for plotting, query or use by SimWise FEA.

Motors, actuators and forces can be driven by the SimWise formula language, tabular data, or from values in an Excel spreadsheet. This allows phenomena like motor start up and spin-down characteristics, variable speed actuators, and electro-mechanical controllers to be incorporated in the simulation model.

Assembly constraints from Alibre Design are automatically and associatively converted to SimWise Motion constraints.

Many times assembly models are over constrained so a "constraint navigator" is available to walk through each motion constraint and modify as necessary to remove redundancies. Limits can be set for constraints to model rotational or translational "stops". Friction forces can be activated on an individual constraint basis by specifying the friction coefficient and a physical
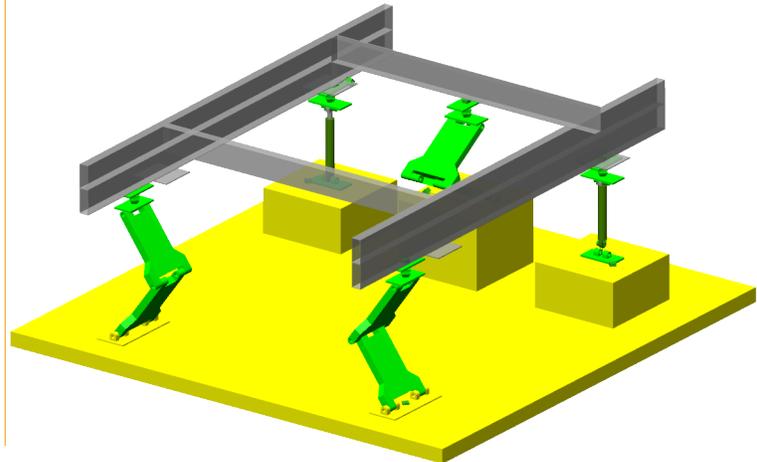
Powerful Formula Language and Function Builder

SimWise contains a powerful formula language that allows simulation entity properties, instantaneous simulation values, and mathematical expressions to be combined into an expression that is evaluated during the simulation and which can be used to define physical values in the simulation. Formulas can also be used to generate values for display on meters. For example the formula:

$0.5*Body[49].mass*mag(Body[49].v)*mag(Body[49].v)$

When added to a meter will display a graph of the kinetic energy of Body[49].

The formula language can also be accessed using a function builder that allows equations to be assembled interactively. The function builder contain an integrated graphing capability so as a function is defined, its graph is displayed and updated.

Programmability

SimWise contains a very rich automation interface which allows it to be both interfaced with and controlled by other applications. Programming languages such as C++, C#, Visual Basic, Java, and even vbScript can be used to customize SimWise. You can automate the integration of SimWise into your proprietary processes and your proprietary calculations can be used from within the SimWise environment.
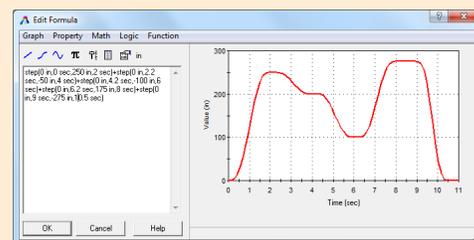
The function builder allows complex functions to be defined graphically

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SimWise Motion for Alibre
3D Motion Simulation

dimension based on the constraint type.

All SimWise Motion objects can be selectively made active or inactive based on some criteria defined by the SimWise formula language. For example, a rotational constraint can be active as long as its reaction force is below a specified value. Once the reaction force exceeds the value, the constraint will deactivate and no longer constrain its attached parts. This would model the effect of the constraint "breaking" due to the internal forces being too high.

The SimWise Motion simulation engine calculates the displacement, velocity, and acceleration of each

body in the motion model and reactions forces that act on each body as a result of its dynamic motion. This includes the motion and forces that result from any collisions between parts.

Each of these quantities can be displayed on meters either in graph or digital format. The values can be accessed with the formula language or tabulated on an HTML report. Graphical vectors can be created that visually show the quantities calculated during the simulation. The vectors can change size and direction as the quantities they display change. Motors and actuators can report their force or power requirements to help you determine the proper sizing of

these elements, and parasitic losses due to friction can be determined.

SimWise Motion help you to answer the question "Does it Work?" and

provides the data necessary for SimWise FEA to help you answer the question "Will it Break?".
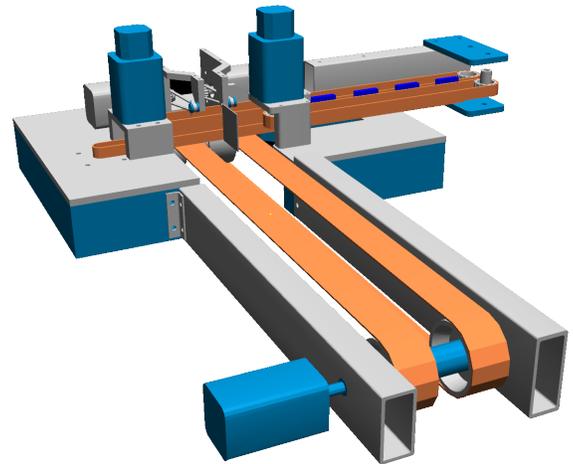
SimWise Motion supports a conveyor constraint for modeling materials handling

An unprecedented Value Proposition

There are many options when choosing a set of CAE tools; FEA applications, 3D Dynamic Motion applications, CAE tools that are part of CAD systems. SimWise sets itself apart in this crowded field because it offers unsurpassed value.

Consider that for a fraction of the price of some single-purpose CAE tools, SimWise delivers:

▶ 3D Dynamic Motion Simulation including contact, friction, formulas, and more.

▶ Linear static, normal modes, buckling, steady state and trasient thermal and combined thermal and structural analysis.

▶ Adaptive FEA meshing providing local mesh refinement in areas of hgh stress gradients,

producing accurate results with minimal input.

▶ Combined Dynamic Motion and FEA analysis allowing the stresses that result from

the dynamic operation of an assembly to be calculated.

▶ The Plug-in for Alibre Design, that allow associated model transfers along with

assembly constraints that are automatically mapped to SimWise joints.

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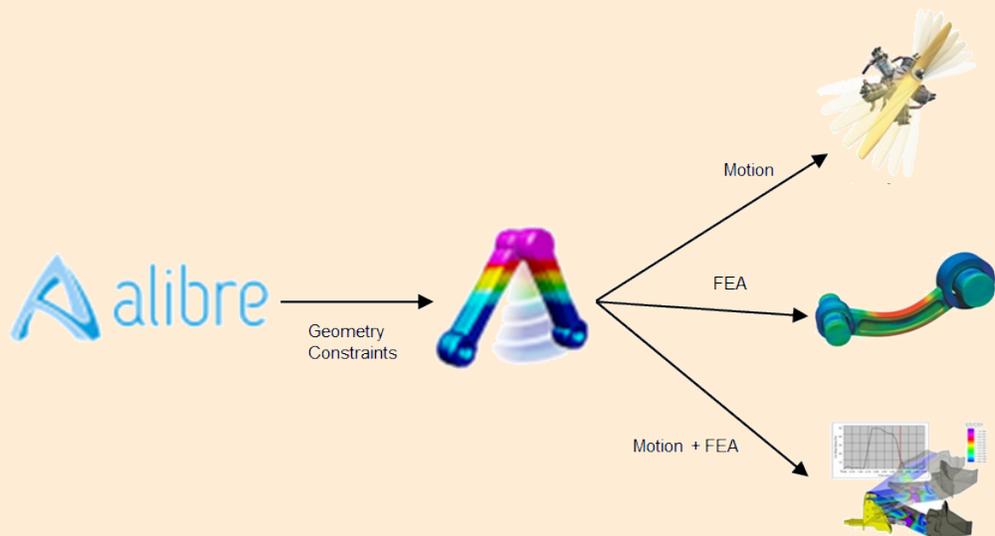
SimWise FEA for Alibre
Mechanical Stress and Thermal Analysis

SimWise FEA is a Finite Element Analysis tool that performs stress, normal modes, buckling, and heat transfer analysis on mechanical parts. It is highly automated and handles much of the complexity associated with FEA while offering powerful features for users who are steeped in the intricacies of the Finite Element Method.

It imports geometry from Alibre Design and allows you to add structural and thermal specific entities to the model resulting in a functional structural prototype of your design. It simulates that prototype using advanced physics and mathematical techniques and presents the results of the simulation in various graphic and numeric formats. You can quickly determine whether your design is robust enough to operate as intended or if modifications are necessary. All on the computer, all without costly and time-consuming physical prototypes and before warranty issues arise.

SimWise FEA has a rich set of functional objects that are added to your Alibre Design model to build a functional structural prototype. These objects include:

- Concentrated loads, distributed loads, torques, and pressures
- Restraints and enforced displacements
- Prescribed temperatures, conductive and convective heat flux, and radiation

All of these values can be driven by the SimWise formula language. All of these objects are applied to the underlying geometry, not to nodes and elements as in a traditional FEA product.

SimWise uses a fast iterative Finite Element Analysis solver that takes advantage of multi-core processors and which is based on a Preconditioned Conjugate Gradient method. SimWise FEA exclusively uses ten-node tetrahedral elements and the solver is optimized for this type of problem.

SimWise FEA performs the following types of analyses:

- Linear Static Stress
- Steady State Thermal
- Trasient Thermal
- Normal Modes
- Buckling
- Combined Thermal/ Structural

SimWise FEA can display FEA results as shaded contours, deformed shapes, or animations. In addition to these engineering values, SimWise FEA also calculates factors of safety and errors in the stress results and both of these can be displayed as shaded contours.
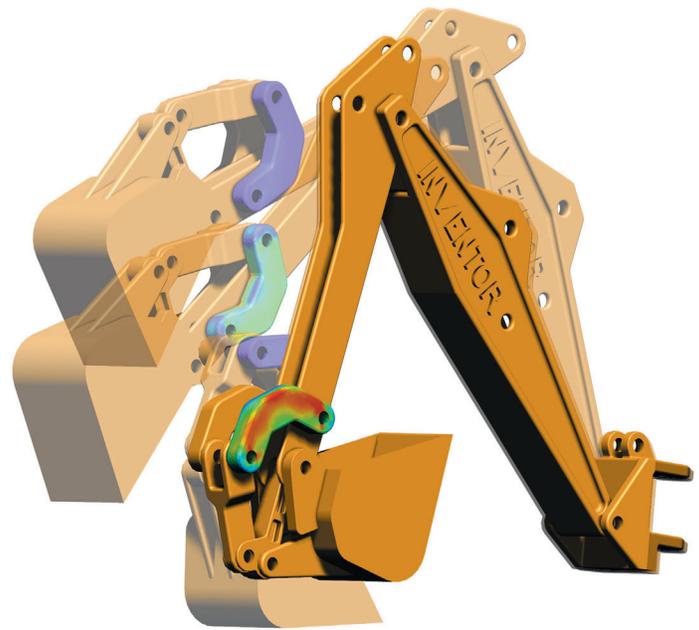
The error results can be used to drive an iterative solution process called h-adaptivity where the error results are used to refine the Finite Element mesh in areas with large error values and use that new mesh to run another solution. The errors in the new solution are compared to a goal and if error values in the model still exceed the goal, the process

in the results are increased and no special knowledge about appropriate meshing techniques is required.

If more control over the mesh is required, SimWise FEA provides mesh controls that can be attached to geometric faces or edges. The control allows the mesh size to be specified on that particular feature and the resulting 3D mesh will be
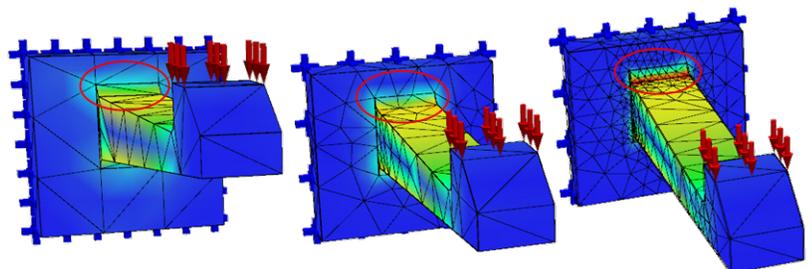
Initial Mesh - Error 13%   Refinement 1 - Error 8%   Refinement 2 - Error < 5%

h-Adaptivity refines the mesh until an error threshold is achieved

is repeated with successive mesh refinements and analyses until the error goal is achieved. Confidence

the specified size along or across the geometric feature.

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SimWise 4D for Alibre Integrated Motion and Stress

Measurable Parameters

Velocities, accelerations and displacements

Force and torque

Friction force, collisions

Interference detection and closest distance between bodies

Motion Drivers

Motor and actuators

Point forces, torques, distributed forces, pressure

Table input, sliders, Simulink controls

FEA

Stress, strain, deflection, vibration, buckling

Heat transfer, h-adaptivity

FEA results meter and factor of safety plots

Advanced mesh control

Input Geometry Formats

ACIS

Constraints

Rigid, revolute, spherical, curved slot, planar

Rods, ropes, springs, gears, belts

Bushings

Generic (user-defined)

Fixed constants on body faces for FEA

Integrated Motion and Stress Analysis

Converts joint forces to distributed loads

Transfers inertial information for stress analysis of parts

Calculates stress and strain at every time step

Utilizes finite element technology to solve redundantly constrained assemblies

Annotation and Dimensioning

Text and pointer annotations, vectors

Distance and radii dimensions
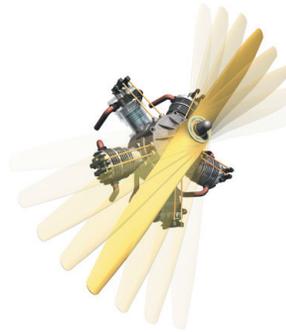
Animation Capabilities

Shadows, surface rendering, and texture mapping

Clipping planes to "cut away" sections

AVI video creation

Output

Meter data from simulations in MS Excel format

Snapshot tool automatically creates JPG, TIF, and BMP image files

DAT files

VRML and HTML files for web distribution

Simulation reports

Ease-of-Use Features

Getting Started

Online Tutorial Guide

Alibre Design Environment Emulation

Transient Zoom

CAD and Other Integration

Alibre Design

Excel

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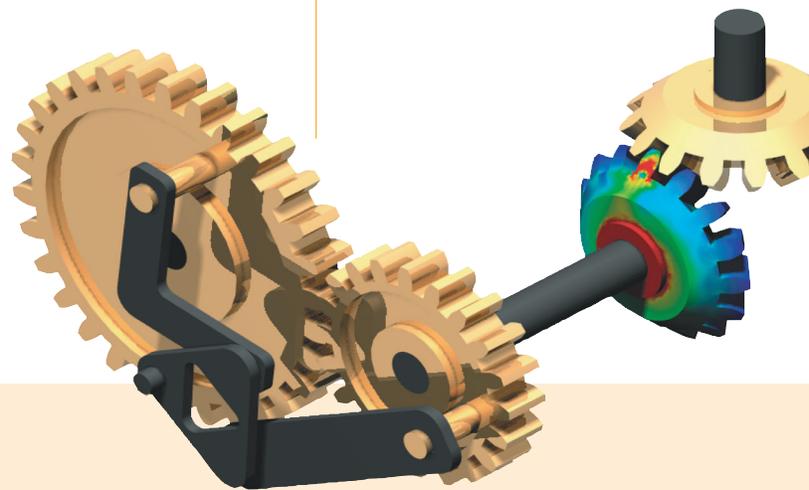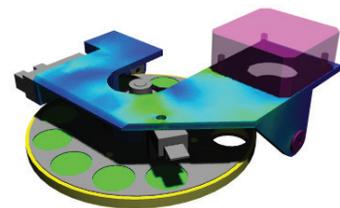
Try it free!

Download your SimWise for Alibre evaluation software at:
www.design-simulation.com/SimWise4D

Questions?

To learn more about SimWise for Alibre, please call us at:
1.800.766.6615 or 1.734.446.6935

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