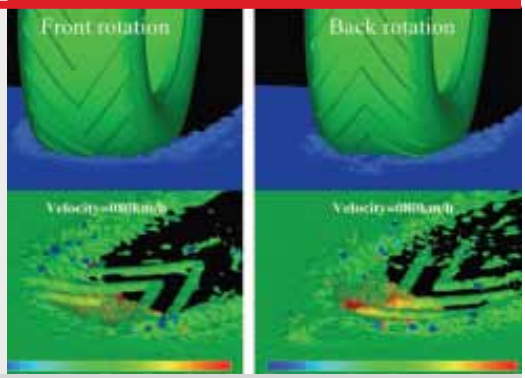
DATASHEET

Dytran

Simulate complex, three-dimensional, dynamic, structural and fluid-structure interaction



Overview

Dytran is a general-purpose, three-dimensional explicit finite element analysis (FEA) software program for simulating and analyzing complex, short-duration events involving severe deformation of structural materials and the interaction of fluids and structures. Dytran provides the most comprehensive and robust solution available to simulate multi-material impact, crush, penetration, explosion, and other fluid-structure interaction (FSI) applications. A broad range of material models and element types enable users in many industries to perform VPD experiments and “what-if” analyses on design concepts before building and testing costly physical prototypes.

Accurate, Robust Analysis for Diverse Applications

Dytran’s accuracy has been proven through correlation with physical experiments. Dytran helps engineers predict how a prototype would respond to a variety of real-world dynamic events and to examine potential causes for product failure. Some industry application examples include:

- Aerospace Applications: Aircraft ditching, fuel tank sloshing and rupture, bird strike simulation, engine blade containment, aircraft crashworthiness, seat design and safety, aircraft and cargo containment hardening.
- Automotive Applications: Airbag design and occupant safety (out of position studies), dummy modeling and seat design, vehicle impact and crash testing, tire hydroplaning, fuel tank sloshing and rupture.
- Military and Defense Applications: Shaped charge simulation and weapons design, projectile penetration and perforation of targets, hydrodynamic ram (HRAM), ship collision, underwater shock explosion (UNDEX), blast resistance and survivability.
- Other Industrial Applications: Bottle and container design, paper feeding, drop testing, sports equipment impact analysis, packaging design.

Unique Combination of Simulation Technologies

Dytran delivers structural, material flow, and coupled FSI analyses in a single simulation package. Explicit nonlinear solver technologies are used to analyze extreme, short-duration, transient events that require finer time steps for ensuring solution accuracy and stability. This allows you

to simulate FEA problems that involve (i) High Degree of Material Nonlinearity, (ii) Large Geometric Nonlinearity, and, (iii) Extreme Boundary Nonlinearity.

Dytran utilizes a Lagrangian solver to monitor the displacements and stresses in structures with a high degree of precision. Complex material flow is modeled by advanced multi-material Eulerian solver technology, with no limit to the amount of deformation in materials being simulated. Interaction between the Lagrangian and Eulerian finite element meshes is achieved through Dytran’s unique, direct coupling feature, enabling an integrated analysis of structural components with fluids and highly deformable materials in one continuous simulation to give you predictive results quickly and easily.

Dytran’s innovative ability to model the interaction of adaptive, multiple Eulerian domains around coupling surfaces as they move and deform gives you the power to analyze complex FSI scenarios that are often too difficult or impossible to simulate with other software tools, such as:

- Multiple objects impacting multi-layered structures (determining the effect of multiple bird strikes against aircraft structures while in flight, for example).

Capabilities

- Advanced, explicit nonlinear solver technology for simulating and analyzing extreme, short duration dynamic events, such as crash, crush, impact, drop, shock, shake, blast, penetration, and sloshing of materials in a variety of industrial and commercial applications.
- Robust and efficient three-dimensional contact and coupling algorithms using Lagrangian finite element method for structural analyses and Eulerian finite volume method for fluids and multi-material flow analyses.
- Complete finite element model library that includes beams, shells, solids, springs, and dampers with large displacement formulation.
- Full range of nonlinear material models for metals, composites, soils, foam rubber, liquids, and gases.
- Distributed Memory Parallel (DMP) support for Eulerian solver and coupling surface computation

Benefits

- Minimize the costs of physical prototyping and eliminate redundant test cycles through Dytran’s streamlined modeling flow and most advanced fluid-structure interaction (FSI) simulation capabilities.
- Quickly obtain detailed insight into the nonlinear, dynamic behavior of real-world problems that cannot be easily solved with other simulation tools.
- Model complex scenarios and perform “what-if” analyses earlier in the design cycle within a single analysis package and simulation environment.
- Apply results from Dytran to improve the quality of your products and minimize the probability of failures and costly redesigns.

Fluid filled bottle droptest

MSC Software

- Catastrophic structural failure with fluid leakage or penetration (examining a vehicle's ability to withstand a crash that would result in fuel tank crushing and fuel spillage, for example).
- Fluid filling and sloshing within an enclosed volume (designing baffles to optimize NVH characteristics for fuel tanks, for example).

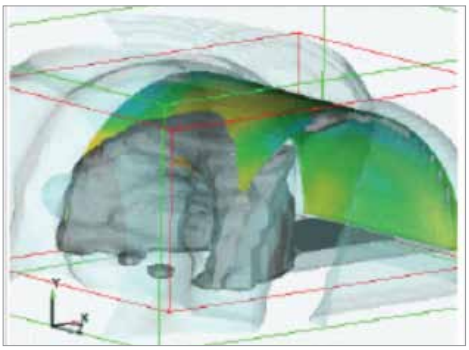
Dytran for Maximizing Productivity

Through continuous enhancements, Dytran has delivered productivity improving capabilities with each new release. Some of the recent technology enhancements include:

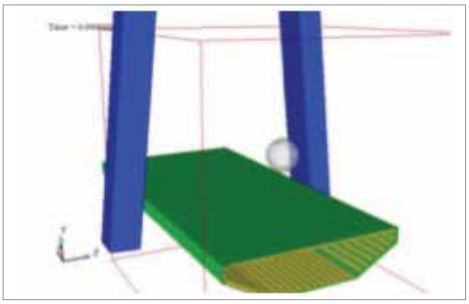
- Distributed Memory Parallel capability of Eulerian solver and coupling surface computation for improved performance gains in FSI applications
- Cyclic flow boundary to help reduce model sizes in simulation of turbines, flow between rotating structures and pipe flow problems
- Body forces that can be applied on different materials inside a particular region defined by a box, sphere, cylinder or a surface.
- Graded Mesh for Euler: With graded meshes, one side of an Euler element can connect to the sides of several other Euler elements, i.e. to "glue" a fine mesh to a coarse mesh, providing an effective modeling flexibility, especially the ones that are only locally non-uniform. This capability will benefit important FSI applications such as airbags/sloshing and blast analysis;
- Non-Uniform Euler Mesh: Capability to allow non-uniform Euler meshing by defining a biased ratio between smallest and large mesh-sizes, thus providing another way for modeling flexibility. Besides, both Graded Mesh and Non-Uniform Mesh for Euler can be used together. This is useful with UNDEX simulations;
- Speed up of Stationary Coupling Surfaces: Coupling surface computation involving the interaction between Euler meshes and Lagrangian structures is very compute intensive. For simulations of using stationary coupling surfaces, algorithmic improvements are implemented resulting in performance improvements of up to 3X. Fuel tanks and sloshing type problems benefit from this enhancement;
- Speed up of axi-symmetric mesh models through time step determination based on the axial and radial directions;
- Naval shipping and UNDEX applications can now use a special boundary treatment defined based on hydrostatic pressure profile;
- For bottle manufacturing, a new capability is introduced to model the gauge pressure in a pressurized bottle, when bottle contracts while the fluid volume expands under loading conditions.
- Modeling of prestressed concrete structures prior to blast or other type of dynamic loadings.
- Modeling of a Laminate Boundary Layer for viscous problems similar to skin friction.
- Restart capability to import the results from a previous run to dramatically improve the simulation time for prestressing and other applications.

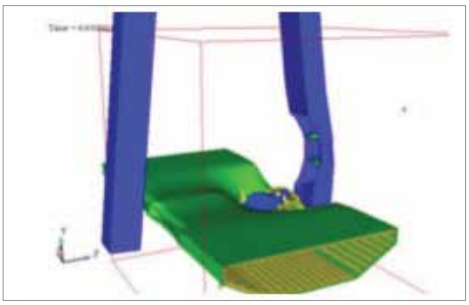
The Dytran product family is supported on all modern UNIX, Linux, and Windows platforms. To provide greater ease-of-use, maintain compatibility with other modeling tools, and enable model re-use, Dytran reads input in standard NASTRAN Bulk Data File (BDF) format. Implicit nonlinear results from MSC Nastran™ can be used to pre-stress structures prior to running dynamic, transient analyses in Dytran for faster throughput.

Dytran is also tightly integrated with Patran® (via Patran's Dytran Preference Module) to give you access to advanced finite element modeling capabilities for conducting a variety of pre and post-processing tasks. Dytran is also supported by CEI EnSight for additional output visualization capabilities that further enhance your ability to interpret simulation results.

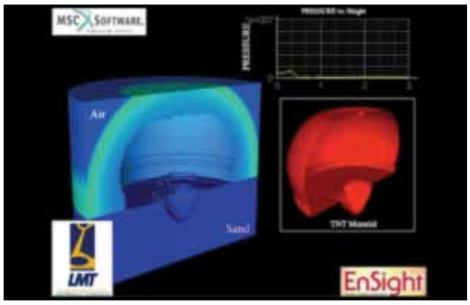


Blast on bunker





Blast on suspension bridge



Landmine Blasts – Courtesy of LMT

Corporate
MSC Software Corporation
2 MacArthur Place
Santa Ana, California 92707
Telephone 714.540.8900
www.mscsoftware.com

Europe, Middle East, Africa
MSC Software GmbH
Am Moosfeld 13
81829 Munich, Germany
Telephone 49.89.431.98.70

Asia-Pacific
MSC Software Japan LTD.
Shinjuku First West 8F
23-7 Nishi Shinjuku
1-Chome, Shinjuku-Ku
Tokyo, Japan 160-0023
Telephone 81.3.6911.1200

Asia-Pacific
MSC Software (S) Pte. Ltd.
100 Beach Road
#16-05 Shaw Tower
Singapore 189702
Telephone 65.6272.0082