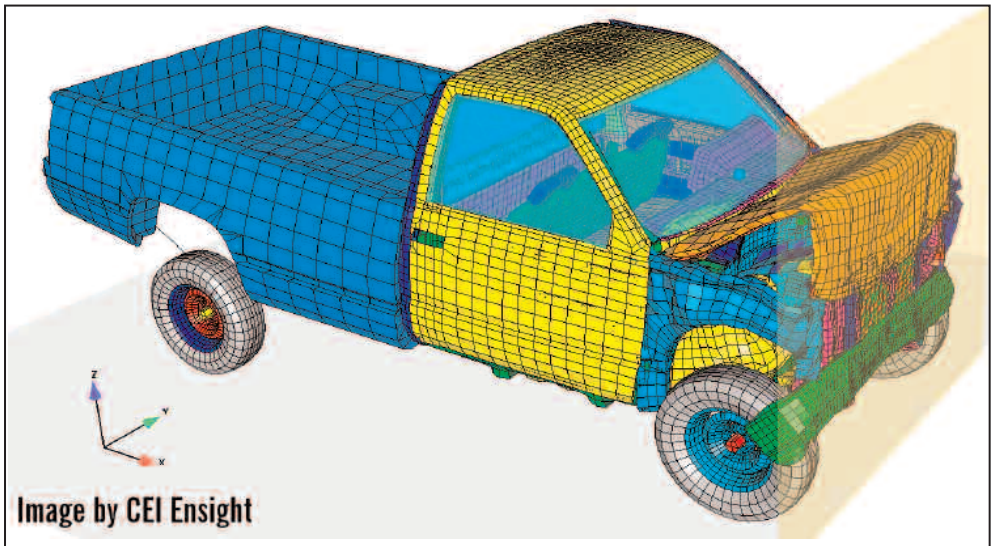
MSC.Dytran®

Simulating Rapid, Extreme Material Deformation & Fluid-Structure Interaction



Truck Impact and Crash Simulation

Overview

MSC.Dytran is a general-purpose, three-dimensional explicit finite element analysis (FEA) software program for simulating and analyzing extreme, short-duration events involving the deformation of structural materials and the interaction of fluids and structures. MSC.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

MSC.Dytran's accuracy has been proven through correlation with physical experiments. MSC.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, tri-hub burst, 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 performance and 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 Commercial and Industrial Applications: Bottle and container design, paper feeding, drop testing, sports equipment impact analysis, component physical design and failure analysis, packaging design.

Capabilities

- Simulates crash, crush, impact, drop, shock, shake, blast, penetration, and sloshing of materials through robust and efficient three-dimensional contact and direct coupling algorithms.
- Provides a complete finite element library to model beams, shells, solids, springs, and dampers with large displacement formulations.
- Full range of nonlinear material models for representing metals, composites, soils, foam rubber, liquids, and gases.
- Delivers high-performance analysis for large structural models through tight integration to an optional, standalone LSTC LS-DYNA Distributed Memory Parallel (DMP) module.
- Uses advanced finite element modeling capabilities of MSC.Patran™ to perform a variety of pre- and post-processing analysis tasks.

Benefits

- 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 MSC.Dytran to improve the quality of your products and minimize the probability of failures and costly redesigns.
- Optimize the structural integrity and performance of your products to meet customer safety, reliability, and regulatory requirements.

MSC Software®

For many applications, destructive "build-and-break" testing is extremely expensive, and the design of prototypes and execution of physical tests are critical to perform right the first time. MSC.Dytran helps to reduce these risks by enabling the virtual simulation of nonlinear impact dynamics and failure effects as part of the VPD process for your applications.

Unique Combination of Simulation Technologies

MSC.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:

- High Degree of Material Nonlinearity: Large or permanent deformation exhibited in metals, foam materials, rubber, and elastomers; flow of fluid, gases, metals, and viscous materials.
- Large Geometric Nonlinearity: Large translations, deformations, or rotations; complete failure of structural parts, including large strains, buckling, crippling, cracking, necking, thinning, breakage, perforations, and distortions.
- Extreme Boundary Nonlinearity: Rapidly changing contact conditions, including self-contact, such as structures bending or folding onto themselves.

MSC.Dytran utilizes a Lagrangian solver to monitor the displacements, deformation, 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 MSC.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.

MSC.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).
- 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).

MSC.Dytran has the advanced simulation technologies required to help you simulate increasingly complex dynamic scenarios and achieve higher design confidence.

Additional Capabilities for Maximizing Productivity

The MSC.Dytran product family includes an optional, standalone MSC.Dytran LS-DYNA™ Module that allows you to execute LS-DYNA from inside MSC.Dytran. Within this common simulation environment, it is also possible to run large structural models on a cluster of CPUs in Distributed Memory Parallel (DMP) mode to help you achieve linearly scalable performance and perform more analyses in less time. The MSC.Dytran LS-DYNA module with DMP capability will operate on either a shared memory system or in a distributed network, and can take advantage of as many processors that are available.

The optional MSC.Dytran Underwater Shock Analysis (USA) Module gives you the ability to run MSC.Dytran with third-party USA boundary element code for underwater shock FSI. This module is ideal for providing an efficient solution to determine the structural response of naval vessels to shock waves and bubble gas expansion resulting from the detonation of underwater explosives. Because it eliminates the need to model fluid volume elements in the medium surrounding the structure, this solution requires less program memory and results in faster simulations.

MSC.Dytran also supports coupled analysis with third-party occupant safety modeling programs, such as the Articulated Total Body (ATB) code, to provide powerful FSI analysis capabilities for these applications. Loosely integrated solutions only allow for data transfers between sequentially running programs, but MSC.Dytran links all libraries into one executable so that data is exchanged concurrently with the ATB program execution for greater accuracy and speed.

The MSC.Dytran product family is supported on all major UNIX, Linux, and Windows platforms. To provide greater ease-of-use, maintain compatibility with other modeling tools, and enable model re-use, MSC.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 MSC.Dytran for faster throughput.

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

MSC.Dytran can also be combined with a full suite of world-class VPD solutions from MSC.Software via the flexible, token-based MSC.MasterKey™ License System.

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Part Number: DT*2005FEB*Z*Z*Z*LT-DAT