Recent Developments in LS-DYNA

John Hallquist, Brian Wainscott, Jason Wang,
and many other developers

Livermore Software Technology Corporation (LSTC), Livermore, USA

1 Introduction

The goal of this presentation is to provide an overview of some recent, ongoing and future developments in LS-DYNA, which is the general-purpose finite-element program of the Livermore Software Technology Corporation (LSTC). LSTC's strategy is to combine multi-physics capabilities into one scalable code for solving highly nonlinear transient problems to enable the solution of coupled multi-physics and multi-stage problems. These coupling capabilities are of great importance when approaching real world problems, as there is no single solution method available that is suitable to solve all applications. Thus, LS-DYNA provides multiple formulations and features, which include

- Explicit and Implicit time integration
- Manifold of 1-d, 2-d and 3-d finite-element discretizations
- ALE & Mesh Free, i.e., EFG, SPH, Particle methods
- Discrete Element Method
- Acoustics, Frequency Response, Modal Methods
- Compressible and Incompressible Fluids
- Electromagnetics
- Over 250 Material models
- Capabilities to parameterize loads and supports
- Strong contact formulations
- Heat Transfer
- User Interface

In addition to being the world leader in automotive crash and manufacturing, LS-DYNA provides the tools to solve applications like

- Tire Hydroplaning
- Airbags
- Hot Forging and stamping
- Bird Strike on Engine
- Drop testing
- Can and shipping container design
- Electronic component design
- Glass forming
- Plastics, mold, and blow forming
- Biomedical
- Metal cutting
- Earthquake engineering
- Failure analysis
- Sports equipment (golf clubs, golf balls, baseball bats, helmets)
- Civil engineering (offshore platforms, pavement design)

LS-DYNA provides two parallel solution methods that are suitable for shared and distributed memory machines, respectively. The distributed memory solver for massively parallel processing (MPP) provides very short turnaround times on Unix, Linux and Windows clusters. To take advantage of new processor architectures, the two approaches have been combined into a hybrid version, that combines the power of shared memory parallelization (SMP) and MPP. This feature improves the scalability of LS-DYNA to more than 10K cores.

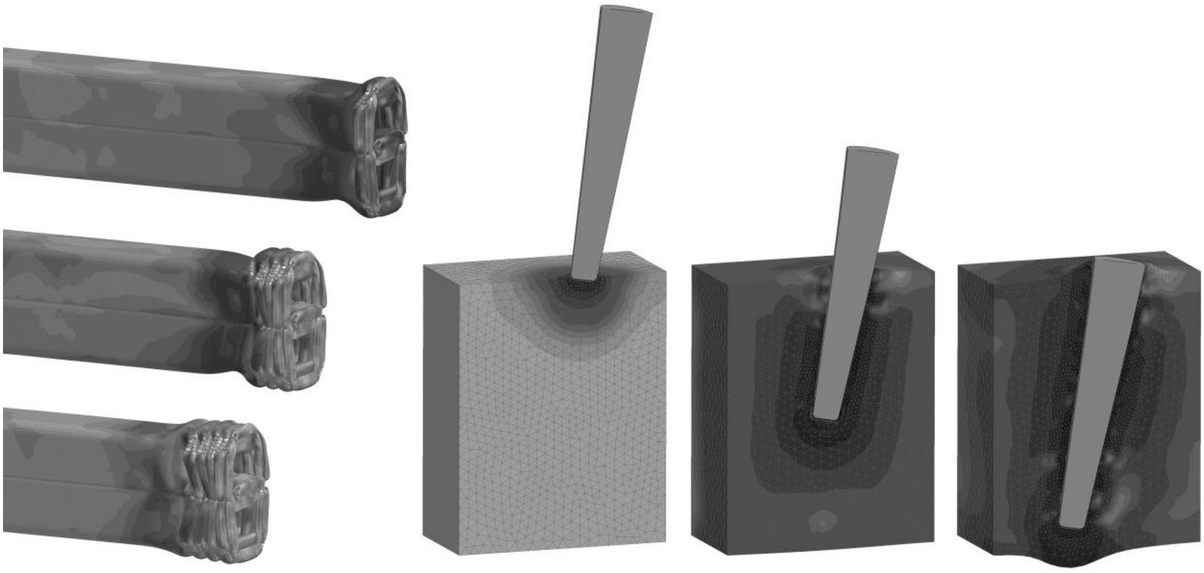
© 2015 Copyright by DYNAmore GmbH

In addition to LS-DYNA, LSTC develops sophisticated tools to support model creation and simulation processes of large deformable structures. In particular, these are

- LS-PrePost: Pre- and postprocessing
- LS-Opt: Optimization and Workflow
- LS-TaSC: Topology optimization

2 Examples

This is a small selection of the many capabilities that have been implemented in LS-DYNA.



a) b)

Fig.1: Improvements on a) the failure modeling of steel materials and on b) the adaptive meshfree methods (EFG).

a) b) c)

Fig.2: Improvements on a) free surface flows, b) fluid-structure interaction on moving reference frames and c) on coupled simulations of different physical fields, i.e. fluid, solid, electro-magnetism and temperature..

3 Historical Review

LSTC was founded in 1987 by John O. Hallquist to commercialize as LS-DYNA the public domain code that originated as DYNA3D. DYNA3D was developed at the Lawrence Livermore National Laboratory, by LSTC's founder, John Hallquist.

© 2015 Copyright by DYNAmore GmbH