SPEED

Shock **P**hysics **E**xplicit **E**ulerian/Lagrangian **D**ynamics

NUMERICS Software

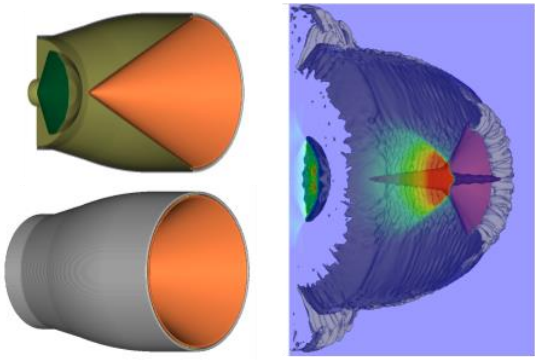
Introduction

SPEED is a multi-material Eulerian / Lagrangian hydrocode with explicit solver technique for the analysis of nonlinear transient problems of shock and impact physics. The software offers a maximum of computational speed as well as superior stability and accuracy. For several years, SPEED has been successfully applied to support our customers in solving research and engineering problems.

Applications

SPEED is an analysis tool for modeling various problems in the field of nonlinear dynamics of gases, fluids and solids. SPEED is used in different areas from conceptual design to post-test simulations and scenario analysis. Typical applications are:

- Detonation and blast propagation
- Optimization of blast-fragment warheads
- Shaped charge design
- Internal detonation and combustion
- Reactive materials, particle burn
- Underwater explosions
- Explosive ordnance disposal
- Tactical ballistic missile defense
- Armor design
- Military, industrial and civil hazard analyses
- Building protection measures in urban areas

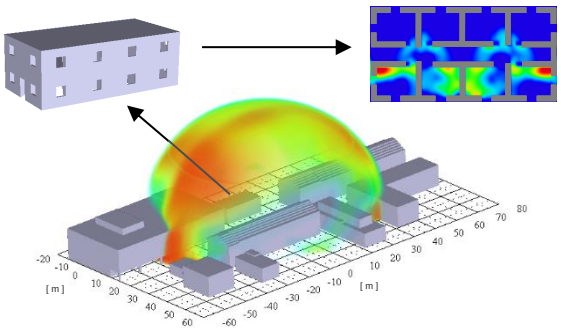


Investigation of a shaped charge in 3D

Compelling Performance

The solver technologies in SPEED are developed to provide significant advantages in performance, e.g.:

- Outstanding computational speed and minimized memory requirements
- Multithreading (multiple CPU shared memory)
- Sharp shock resolution and higher order advection schemes to limit diffusion
- Robust algorithms for multi-material cells
- Intuitive user interface for an interactive model setup
- Outstanding post-processing capabilities



3D blast simulation in an urban scenario

Code Features

Solver Options

SPEED offers the full spectrum of analysis capabilities like

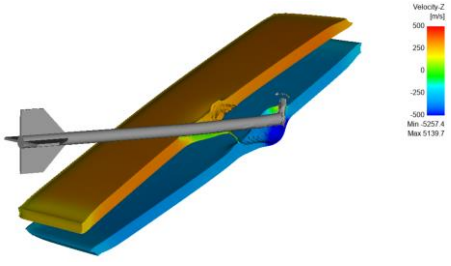
- Multi-Material Euler (2D Cartesian and rotational symmetry, 3D Cartesian)
- Ideal gas Godunov solver (3D Cartesian)
- Lagrange solver (2D plain strain and rotational symmetry, 3D Cartesian)
- Lagrangian contacts and erosion
- Embedded rigid bodies
- Adaptive mesh expansion / translation
- Mesh activity control
- Mapping: 2D to 2D, 2D to 3D and 3D to 3D

Material Models and Material Library

SPEED includes a comprehensive library with more than 250 material data sets for gases, fluids, metals, plastics, concrete, soils and many others. A variety of constitutive relations offers the possibility to accurately model the response of materials to dynamic loads. Amongst others, the following constitutive models are available:

Equation of State (EOS) Models

- Ideal Gas (Constant-Gamma, $c_v(T)$)
- Liquids (Universal Liquid EOS)
- Explosives (JWL, TD-JWL)
- Explosive burn and combustion model
- Explosive initiation (HVRB, Lee-Tarver)
- Solids (Mie-Gruneisen, Tillotson)
- Porous solids (p-alpha)



3D-FE simulation of KE penetrator impacting ERA

Strength Models

- Solids (Elastic-plastic with work hardening)
- Metals (Johnson-Cook, Zerilli-Armstrong, Steinberg-Guinan)
- Concrete (Holmquist-Johnson-Cook, RHT)
- Ceramics (JH-2)
- Soils, granular materials (Drucker-Prager)

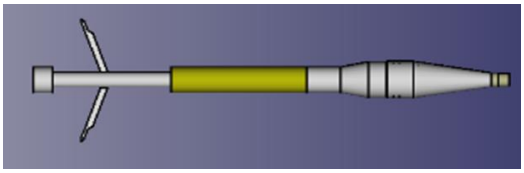
Failure Models

- Plastic failure strain
- Johnson-Cook damage model
- Accumulated spall damage
- Xue-Wierzbicki

Pre-Processing

SPEED offers an intuitive and interactive model setup. It provides an easy-to-use constructive solid geometry modeler as well as an integrated CAD module to setup or import arbitrarily complex geometries. Further highlights are:

- Geometry import from LS-DYNA and ANSYS AUTODYN
- Visualization during model setup
- Individual setting of units (metric or imperial)
- Tools to convert elastic constants and hardness-to-strength



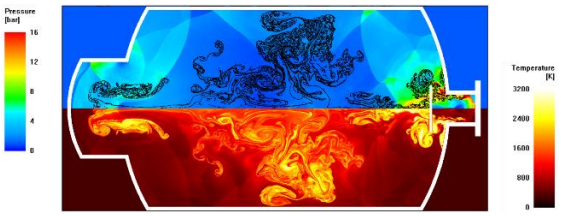
3D CAD model of a rocket-propelled grenade

SPEED is designed to support parametric studies. Its object-oriented model structure requires only a minimum of user effort to modify and re-run a simulation.

Post-Processing

The code offers a variety of functionalities for the evaluation and illustration of the results.

- Visualization of scalar, vector, tensor data
- Arbitrary mix of rendering techniques (sliced plots, surfaces, volume rendering)
- Profile plots
- Material and gauge time histories
- Signal processing options (filter, frequency analysis, integration, derivative, …)
- Mass / velocity distributions for shaped charge jets and behind armor debris
- Export of text & graphics to MS applications
- Movies (avi-files)



2D detonation simulation including combustion in a detonation vessel

Cost and Productivity Benefits

Efficient algorithms guarantee high computational speed and low memory demand. High productivity is ensured by

- the superior stability that saves manpower,
- the generally included multithreading capability that saves computation time,
- a job queue mode that permits to process simulations without requiring user activities,
- a carefully compiled and tested material library that saves model setup time, and
- the intuitive user interface that significantly reduces the teach-in phase.

The complimentary SPEED***PrePost*** app offers efficient and flexible model setup and result evaluation or presentation without blocking a license.

Last but not least: Its attractive price makes SPEED affordable for everyone.

Additionally, NUMERICS offers basic and advanced training courses.

Licensing

SPEED is for use on PC systems running under all current Windows operating systems. It may be leased on an annual basis or purchased as a paid-up license for perpetual use. Various licensing options are available for SPEED ranging from single-user to enterprise network solutions.

Services

- NUMERICS provides full technical support and customer service for all users.
- SPEED is continually developed to maintain and enhance its capabilities and to incorporate the suggestions of its users.
- On request, NUMERICS also offers support in tailoring SPEED for specific structural codes and applications.

NUMERICS Software GmbH · Mozartring 3 · 85238 Petershausen · Germany
Phone +49-8137-998586 · E-Mail: info@numerics-gmbh.de · Website: www. numerics-gmbh.de