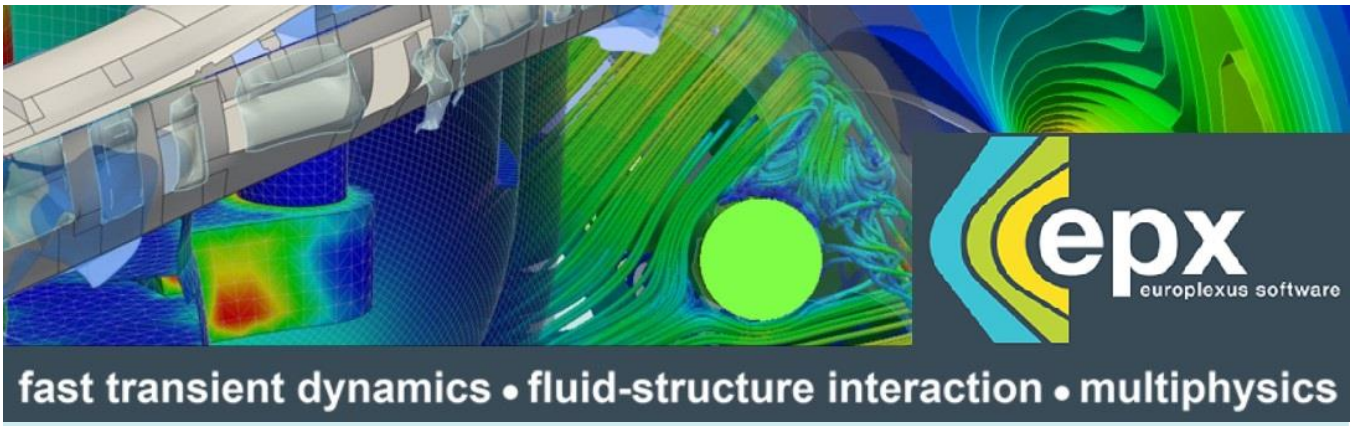
JRC 135475

European Commission

SCIENCE FOR POLICY BRIEF

Data and Tools to Counter Terrorism

Europlexus – Your way to fast transient phenomena analysis



HIGHLIGHTS

→ Europlexus (EPX) is an advanced scientific software dedicated to the analysis of fast transient phenomena involving structures and fluids in interaction

→ The free EPX version 'Education and Research Light' for sequential or parallel simulations is available with a limited maximum number of 20 000 structural and 200 000 fluid elements

→ EPX is also available as a licensed version and as a free licensed version for academics with full content and features

→ JRC provides publicly-available video tutorials for new users in a self-study mode covering basic functionalities, practical case studies and the post-processing of results

Europlexus – What is it?

Europlexus, or short EPX, is a simulation software dedicated to the analysis of fast transient phenomena involving structures and fluids in interaction. The program is co-owned by the French Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA) and the Joint Research Centre of the European Commission (EC/JRC). Its development is carried out through a Consortium involving the co-owners and so-called major partners who are granted a complete access to the source code.

What can it do for you?

EPX is based on a space discretization by means of Finite Elements, SPH Particles (Smooth Particle Hydrodynamics) or Discrete Elements for structures, or by means of Finite Elements, Finite Volumes or SPH Particles for fluids. Time integration is achieved through a conditionally stable explicit scheme.

The solving algorithm is completely non-linear, at both geometric level (large displacements; large rotations) and

material level (constitutive laws implementing plasticity or damage for example).

The programme provides a large number of kinematic links between entities, for instance for boundary conditions, contact between structures or fluid-structure interaction. EPX is characterized by its minimal use of non-physical parameters to enforce these links, such as penalty coefficients. It relies on direct methods to compute the link forces whenever it is possible and otherwise, the links are dualized by means of Lagrange Multipliers, the unknown forces being then deduced from the resolution of an additional linear system.

Structural dynamics

EPX implements specific models able to analyse various mechanical situations, such as shocks, impacts, explosions, wave propagations and their consequences on structures.

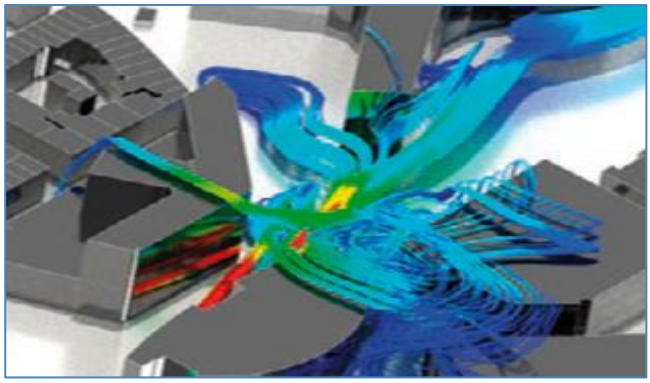
Spatial discretization for structures is mainly achieved through finite elements, but some meshless models, such as SPH particles, or discrete models are also available.

LEARN MORE Europlexus is an advanced scientific software used mainly for analysing the consequences of blast and impact loads on structures, for example in the context of protection of public spaces or critical entities. The use of Europlexus requires extensive training. JRC seeks to facilitate the initiation of new users in their first steps by providing publicly available *video tutorials* in a self-study mode on subjects like FE mesh preparation, the structure of EPX input files, material modes, element types, case studies on blast, impact and fluid-structure interaction, as well as the use of post-processing tools.

Fast transient fluid dynamics

EPX implements advanced fluid models and Finite Volume schemes for multi-component flow, reactive flows or multi-phasic flows.

Figure 1 –Europlexus blast simulation with channeling phenomena



Strongly coupled dynamics

EPX implements kinematic constraints of many kinds to provide boundary conditions and couplings between entities, such as unilateral contact between different pieces of structures, fluid-structure interaction or coupling between different formulations (pipe SPH-Finite Elements, Discrete Elements-Finite Elements...).

Arbitrary numerical parameters are avoided in the way these constraints are enforced, mainly by means of a dual approach through Lagrange Multipliers.

Assessing vehicle impact on security barriers

Europlexus helps the JRC to do detailed modelling of vehicle impacts on security barriers in order to support counter-terrorism activities in the domain of the protection of public spaces and critical entities.

In this context, JRC also develops publicly available *generic numerical vehicle models*.

https://counterterrorism.ec.europa.eu/

http://www-epx.cea.fr/