



## MARKET CHALLENGES

Partial differential equations appear in many problems of physics (mechanics, thermodynamics, acoustics, etc.), engineering, economy, finances... In numerical analysis, the finite element method is used to solve numerically these equations.

Facing complexity and variety of possible uses, the development of a flexible software allowing to code quickly a multiphysical problem, is necessary. Besides, researche in the domain being in constant progress, an open-source software is essential to be able to benefit from the last advances of solvers and/or meshing.



## INNOVATIVE SOLUTIONS

Fruit of a long maturing process, FreeFem++ is a high level integrated development environment (IDE) for numerically solving partial differential equations (PDE) in dimension 2 and 3.

FreeFem++ has an advanced automatic mesh generator, capable of a posteriori mesh adaptation; it has a general purpose elliptic solver interfaced with fast algorithms such as the multi-frontal method UMFPACK, SuperLU. Hyperbolic and parabolic problems are solved by iterative algorithms prescribed by the user with the high level language of FreeFem++. It has several triangular finite elements, including discontinuous elements.



## SUGGESTED APPLICATIONS

Main use :

- Teaching of the finite element method, PDE, weak form and variational form
- R&D and academic research : quick test of new ideas or multi-physics and complex applications, algorithms prototyping

Domain :

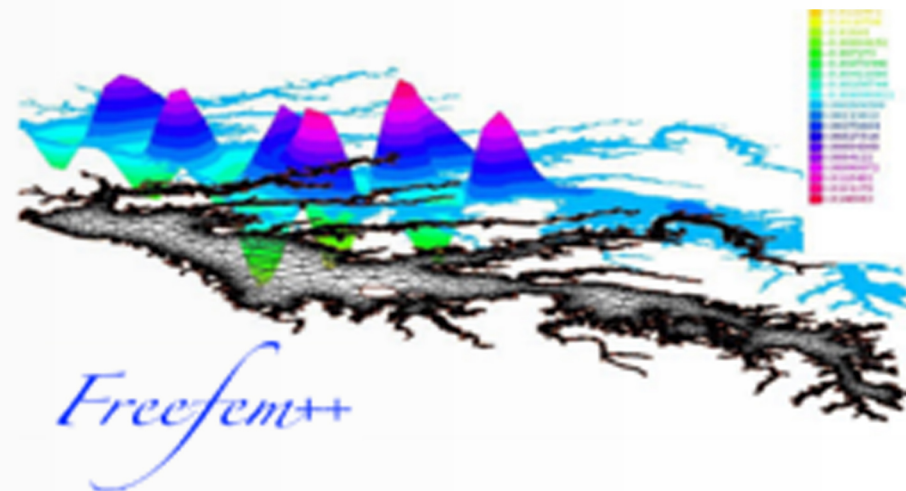
- Physical engineering (thermodynamics, mechanics, fluid mechanics, neutron physics, porous environment, etc.)
- Mathematical engineering



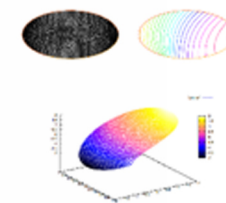
## DEVELOPMENT STATUS

FreeFem++ is written in C++ and the FreeFem++ language is a C++ idiom. It runs on Macs, Windows, Unix machines.

FREEFEM ++ was applied successfully in the industrial domain (eg: HUSKY: molding process modeling; PHONON: Analysis of SAW Transducer).



Exemple: application to the equilibrium of a membrane under load. Mesh and level lines of the membrane deformation.



## COMPETITIVE ADVANTAGES

- Flexible
- Open-source
- Speed of the multiphysical problem coding
- Better efficiency of the modelling
- Success in academic and research domains with a community of more than 2000 users
- Recognized expertise in modelling of the laboratory having developed FREEFEM ++, the Laboratoire Jacques Louis Lions (LJLL)