

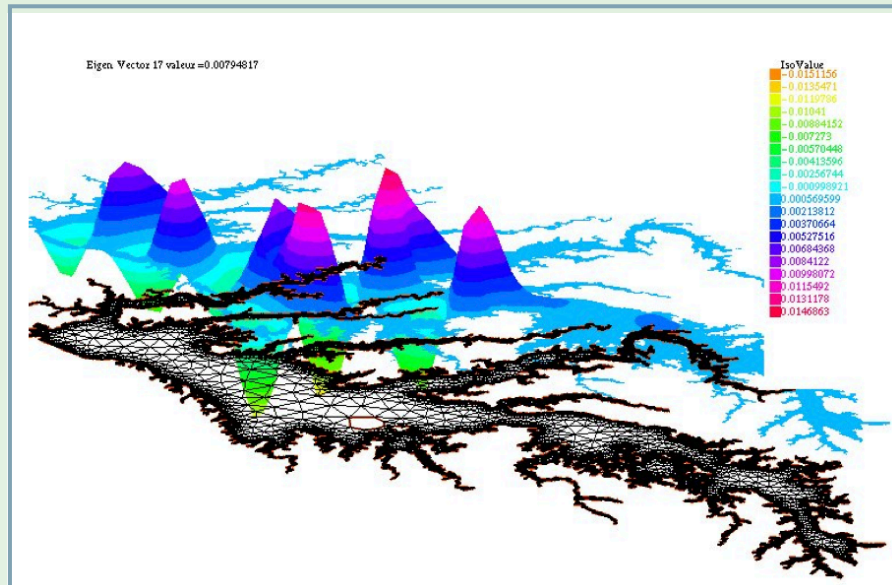
Learn to use the General Purpose User Friendly PDE Solver

freefem++

<http://www.freefem.org/ff++>

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MATH. DEPT. UNIVERSITY OF HOUSTON



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The authors of `Freefem++v3` will cover the essential of the software's capabilities from simple equations and systems such as Laplace or Lamé equations to coupled nonlinear 3D problems multi-physics using exotic finite element method and parallel linear solvers. `Freefem++` is user friendly with an instantaneous learning curve; it has its own language close to math such as

```
solve a(u,v)=int2d(Omega)(dx(u)*dx(v)+dy(u)*dy(v))+on(gamma,u=1);
```

and its own graphics; it is an ideal tool for teaching numerical methods for PDE and it is also very convenient for prototyping new ideas at a research level.

Lectures in the mornings will be followed by tutorials in the afternoons. The following will be covered: automatic mesh generation and adaptation, Poisson, Stokes, Maxwell, Boussinesq and Navier-Stokes equations. Applications to structures, fluids, thermics, acoustics, waves and coupled and/or time dependent problems with moving domains; optimization, control and optimal shape design. Domain decomposition and solution on a parallel computer using embedded `mpi`. Most of the above can be done in 3D also. Almost all existing FEM can be used but on triangles/tetraedra. It runs on PC, Mac and Linux.



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Program

Day 1

Introduction (O.P.) 90 min.

Basic syntax of freefem++ ; history, the 3 main building blocks, mesh generation and adaption. Some hints on the internal structure of freefem++.

Lecture 1 (F.H.) 90min. Structure mechanics with freefem++ : Laplace, Lamé, and eigen modes. Introduction to 3D problems.

Tutorial 1 (F.H & O.P.) 120 min.

Installation on a PC. Some basis examples; Mesh generation and mesh adaptation ; a minimal surface problem. Sample problems to try at home.

Day 2

Lecture 2 (O.P) 90 min. Fluid Mechanics with freefem++

Flow through porous media, convection – diffusion problems (including DG methods). Navier-Stokes and Shallow water equations. Optimisation and control problems.

Lecture 3 (F.H.) 90 min. Advanced technique

Problems using complex numbers. More 3D problems. Linear and non-linear solvers. parallelization by domain decomposition, Non standard Finite Elements.

Tutorial 2 (F.H & O.P.) 120 min.

Each participant will choose a problem from a list and try to solve it, assisted by FH and OP.

Prerequisites

Participants are expected to have a basic knowledge of variational formulations and the finite element method. No prior knowledge about linear solvers or programming (matlab type) is needed but it helps.

Participant should come with their PC (Mac OSX 10.6 or above, Windows XP or above, Linux Debian/ubuntu, others need recompilation of the source code).