StabFem : a Matlab/Octave interface to FreeFem++ for flow instabilities and wave problems, designed for research and education.

D. Fabre, D. Ferreira Sabino, J. Sierra, V. Citro, F. Giannetti & M. Pigou

Abstract : The FreeFem++ software is currently a popular tool in the research community of flow instability. In our teams, it has been used for a variety of problems, including wake instabilities of fixed or freely moving objects, rotating free-surface flows, oscillations of capillary bridges and hanging droplets, instabilities of compressible jets, linear acoustics, etc… The ambition of the StabFem project is to contribute to the popularization of flow instability studies by providing a common, user-friendly, and easily customizable interface to such programs. The project is collaborative and developed on an open-source and multi-platform basis [1,2]. The software combines the powerful capacities of FreeFem++ with the versatility of the Matlab/Octave environment for computation monitoring and graphical post-processing.   The suite consists of two sets of programs: a number of FreeFem++ solvers (incompressible/compressible, 2D / axisymmetric, free-surfaces, etc…) performing the main steps of the computation (building of linear operators and resolution of linear problems, mesh design and adaptation…) complemented by a limited number of generic wrappers. The software allows to conduct a whole parametric study (generation of adapted mesh, computation of a family of base flows, computation of eigenvalues with loop over parameters, and graphical post-processing of the whole results) within a single Matlab/Octave script of about one page, with a common syntax. The software is expected to be useful at two levels : (i) for education (particularly at premaster level), the software allows students to have a touch on the numerical resolution of complex problems while staying in a familiar Matlab/Octave environment. (ii) for research, easiness of customization will allow researchers to incorporate their own solvers in the project and benefit of all the features currently implemented in the interface to efficiently speed up the process of a parametric study. In this presentation, the implementation principles of the interface will be briefly explained. Then, the current possibilities of the software will be illustrated by a number of results coming from both education and research.

References :
[1] https://github.com/erbafdavid/StabFem
[2] D. Fabre, V. Citro, D. Ferreira Sabino, P. Bonnefis, & F. Giannetti (2018) A practical review to linear and nonlinear approaches to flow instabilities. Appl. Mech. Rev. (submitted)
https://github.com/erbafdavid/StabFem/blob/master/99_Documentation/ARTICLE_STABFEM/ARTICLE_ASME_Submitted.pdf