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VIBRATIONS OF A MTR FUEL ELEMENT IMMERSED IN FLUID

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Abstract. The computation of the normal modes of solid structures interacting with fluids is very important in many engineering applications, such as the design of heat exchangers, condensers and other devices. In particular, it is especially interesting for us to analyze the vibrations of a MTR fuel element interacting with the fluid flowing through it.

In this work we studied the three-dimensional vibration problem of a MTR fuel element interacting with an ideal compressible fluid, which extends what was done in the work "Vibration of a Reissner-Mindlin plate immersed in fluid in 3D" presented in the XX Congress on Numerical Methods and Applications.

The plates of the fuel element were modeled using the Reissner-Mindlin's equations and the Durán-Liberman's mixed elements, while for the access nozzle of the fuel element we used the 3D elasticity equations and the tetrahedral elements. For the fluid we employed the equations of a compressible ideal fluid with the displacements as primary variables and the Raviart-Thomas' elements of order 0. The kinematic coupling between the plates, the nozzle and the fluid was modeled introducing the pressure on the interface as a new variable in the problem. Making the coupling in this way enables the use of non-matching grids at the interfaces, allowing the plates, the nozzle and fluid to be refined separately as needed.

In the first part of the work, a module to solve vibrations problems of solids with 3D elasticity interacting with fluid was developed and incorporated into the plate-fluid interaction code presented last year. Results (modes and frequencies) in the validation of the 3D elasticity modulus are reported. Finally, preliminary results of a vibration analysis of a MTR fuel element are shown.