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SPH method for simulation of transient flow coupled to large strained cracking shells

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This presentation is devoted to the prediction of fluid flow resulting from severe impacts on shells filled with fluid. The crucial parts are modelled with SPH: the fluid is SPH and the cracking shell is modelled with SPH Shells. The remaining parts of the structure are modelled with standard finite elements. The presentation will consist in two parts:
-the first one will explain how one can couple an explicit structural code (which includes SPH Shell models) to represent the cracking solid part and a SPH code to represent the fluid flow. It will be shown that this coupling can in the same time be non intrusive, and ensure a zero numerical energy on the interface.
-the second one will illustrate the application of these methods to analytical simple examples for non leaking shells and then show the interpretation of published experiments.

The non intrusive coupling method is based on the concept of simplectic interface energy formulation. This concept is an extension of the well-known variational time integrators to interface energy. The proposed method is also able to cope with incompatible time steps in the parts or sub domains [1][2]. As the interface energy is perfectly controlled, one is sure that the interface terms do not inject or remove any energy as time passes.

The method will be illustrated on 3 types of examples: a first one is dedicated to a linear 3D tube experiment example showing the quality of the coupling method. The second one will show complex transient fluid structure computations with huge fluid flow and large structural displacements. The last one shall show the development of a crack and the consecutive fluid flow in case of a severe impact fluid loading: the results are compared with experiments

3D computation of FSI interaction and fluid leakage and final experimental crack.

REFERENCES

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