Immersed interface method for the propagation of transient mechanical waves

Bruno Lombard
Laboratoire de Mécanique et d'Acoustique,
31 chemin Joseph Aiguier, 13402 Marseille
lombard@lma.cnrs-mrs.fr
http://www.lma.cnrs-mrs.fr/~MI

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Abstract

The finite-difference schemes on cartesian grids are very efficient to simulate the wave propagation in homogeneous media. However, interfaces damage these qualities, for the following reasons:

- *numerically* : non-smoothness of solutions across interfaces decreases the order of convergence, and instabilities may be triggered;
- *geometrically*: a stair-step representation of interfaces on cartesian grid gives birth to spurious diffractions;
- *physically*: finite-difference schemes do not incorporate the jump conditions.

To solve these problems, we propose to apply an *immersed interface method* [1]. Locally, some numerical values used for time-marching are modified, based on the jump conditions and on the geometrical features of the interface. This method is coupled straightforwardly to conservative schemes for hyperbolic systems. The additional cost is negligible compared to the cost of the scheme.

Various applications of the method will be presented, to cite a few: linear [2] and non-linear [3] jump conditions between solids, poroelastic media [5], free surface in seismology [4]. We will conclude with a short presentation of our 2D software [1].

References

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