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Universitat Politècnica de Catalunya, Barcelona, April 15–19, 2013

Numerical Simulation of Fast Transient Dynamic Phenomena in Fluid-Structure Systems

Questions/Exercises on Part IV

Note: some questions may admit more than one answer. You may mark all answers you think are appropriate, and eventually add some comments of your own.

1. In an ALE description for structures (solids) the major difficulty with respect to fluids is:
    a. The mesh rezoning algorithm
    b. The stress transport algorithm
    c. The presence of materials with memory
2. In the proposed ALE description for structures time integration is:
    a. Implicit
    b. Explicit
    c. Explicit but requires a fractional step approach like in fluids
3. The main advantage of using ALE for structures is that:
    a. It increases the precision of numerical solutions
    b. It allows to treat problems with larger deformations thanks to rezoning
    c. It always reduces the CPU time
    d. It reduces the CPU time in problems with very large deformations
4. In the proposed strategy for non-conforming FSI, velocity compatibility constraints are based upon:
    a. Every fluid node along the F-S interface
    b. Every structural node along the F-S interface
    c. Every fluid and every structural node along the F-S interface
5. The best configuration in non-conforming FSI is usually:
    a. Hierarchic (fluid finer than structure)
    b. Hierarchic (fluid coarser than structure)
    c. There is no clear advantage of hierarchic or of non-hierarchic
6. The proposed non-conforming FSI technique:
    a. Typically allows direct solution of constraints at non-matching nodes
    b. Leads to a coupled set of equations similar to the conforming case
    c. Leads to a coupled set of equations with larger bandwidth, thus requiring increased memory storage and CPU time

7. Conventional contact-impact methods based upon slide lines or slide surfaces:
    a. Always detect penetration
    b. May fail to detect penetration in complex or ambiguous cases
    c. May lead to redundant contact detections
8. Pinball-based contact-impact methods:
    a. Always detect penetration
    b. May fail to detect penetration in complex or ambiguous cases
    c. May lead to redundant contact detections
9. In the contact-impact methods illustrated in the Course, solution by Lagrange multipliers:
    a. Must be used in the pinball-based method
    b. May not be used in the slide line or slide surface method
    c. May be used in either method
    d. Must be used in the slide line or slide surface method
10. So-called Spectral Element methods are useful/convenient for:
    a. Problems with sharp discontinuities
    b. Problems with smooth solutions
    c. Linear problems
    d. Highly non-linear problems
11. In spectral elements the nodes are:
    a. Uniformly spaced in each element
    b. Randomly spaced in each element
    c. Non-uniformly spaced in each element, at special positions
12. Coupling of spectral elements and finite elements:
    a. Is only possible when the two meshes are conforming
    b. Is preferably done by local (node-by-node) conditions, like in FSI
    c. Is preferably done by integral conditions such as the mortar method
13. The proposed spatial partitioning technique is based upon:
    a. A binary (2-based) partition of the time step over the spatial mesh
    b. An arbitrary partition of the time step over the spatial mesh
    c. A graded mesh with a binary (2-based) size ratio between neighboring elements
14. In principle, the proposed domain decomposition technique allows:
    a. Using different time steps in each sub-domain
    b. Using sub-domains with non-conforming interfaces
    c. Using different time integration schemes in each sub-domain
    d. Mixing up modal analysis and direct time integration
15. From the user's viewpoint, spatial partitioning is:
    a. Much simpler to use than domain decomposition, but less general
    b. More difficult to use than domain decomposition, but more general
    c. About equivalent to domain decomposition in both respects

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Overall Course evaluation

The Course has presented a set of techniques and of models for the numerical simulation of fast transient problems in fluid-structure systems, with special emphasis on FSI issues. In your opinion:

- What are the strong points (if any) of the proposed methods and models?

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- What are the weak points (if any) of the proposed methods and models?

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- What remains to be developed and which are the priorities?

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