On parallel scalability aspects of strongly coupled partitioned fluid-structure-acoustics interaction

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Abstract

Multi-physics simulations, such as fluid-structure-acoustics interaction (FSA), require a high performance computing environment in order to perform the simulation in a reasonable amount of computation time. Currently used coupling methods use a staggered execution of the fluid and solid solver [1], which leads to severe load imbalances.

In [2] a new coupling scheme based on a quasi-Newton method is proposed for fluid-structure interaction which couples the fluid and solid solver in parallel. The quasi-Newton method requires approximately the same number of coupling iterations per time step compared to a staggered coupling approach, resulting in a better load balance when running on in a parallel environment.

This contribution investigates the scalability limit and load-balancing for a strongly coupled fluid-structure interaction problem, and also for a fluid-structure-acoustics interaction problem. The acoustic far field of the fluid-structure-acoustics interaction problem is loosely coupled with the flow field.

References

[1] J. Degroote, K.-J. Bathe and J. Vierendeels, *Performance of a new partitioned procedure versus a monolithic procedure in fluid-structure interaction*, in Computers and Structures 87, pages 793-801, 2009.

[2] M. Mehl, B. Uekermann, H. Bijl, D. S. Blom, B. Gatzhammer and A. van Zuijlen, *Parallel coupling numerics for partitioned fluid-structure interaction simulations*, in SIAM Scientific Computing, submitted, 2014.