Barker, Andrew T.; **Cai, Xiao-Chuan**

NKS for fully coupled fluid-structure interaction with application. (English) Zbl 1284.74029

Bercovier, Michel (ed.) et al., Domain decomposition methods in science and engineering XVIII. Selected papers based on the presentations at the 18th international conference of domain decomposition methods, Jerusalem, Israel, January 12–17, 2008. Berlin: Springer (ISBN 978-3-642-02676-8/hbk; 978-3-642-04466-3/ebook). Lecture Notes in Computational Science and Engineering 70, 275-282 (2009).

Summary: Newton-Krylov-Schwarz algorithms have been used in many areas and are often quite scalable and robust. In this paper we explore the application of Schwarz type domain decomposition preconditioners to some fully coupled systems for fluid-structure interaction. In particular, we are interested in developing a scalable parallel framework for the simulation of blood flow in human arteries [*A. Quarteroni* et al., Comput. Vis. Sci. 2, No. 4, 163–197 (2000; Zbl 1096.76042)]. In [*Y. Bazilevs* et al., Comput. Mech. 38, No. 4–5, 310–322 (2006; Zbl 1161.74020); *C. A. Figueroa* et al., Comput. Methods Appl. Mech. Eng. 195, No. 41–43, 5685–5706 (2006; Zbl 1126.76029)], coupled fluid-structure problems are solved in 3D for patient-specific artery models, with emphasis on accurately representing vessel geometry, on constitutive model for the artery walls, and other physical concerns. In this paper we focus on a class of parallel domain decomposition algorithms for solving the coupled systems and report on the robustness and parallel scalability of the algorithms. Very often in the simulation of fluid-structure interaction, fluid and structure are iteratively coupled, as in [L. Formaggia et al., K. Hunter et al.]. That is, fluid and structure subproblems are solved alternately (or in parallel), passing boundary conditions between them, until the solutions are compatible at the fluid-structure interface, and then the simulation proceeds to the next time step. However, this approach often requires small timesteps, can become unstable, and can reduce the order of accuracy of the solution [*E. Kuhl* et al., Int. J. Numer. Methods Eng. 57, No. 1, 117–142 (2003; Zbl 1062.74617)]. In contrast, we use fully monolithic coupling, where the fluid and the structure are solved together as one system.

For the entire collection see [Zbl 1178.65001].

MSC:

74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
65M60 Finite element, Rayleigh-Ritz and Galerkin methods for initial value and initial-boundary value problems involving PDEs

Software:

PETSc

Full Text: DOI Link