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Algebraic Multigrid in Fluid Structure Interaction Biomechanics

*** Michael W. Gee[1], Wolfgang. A Wall[1]**

[1] Chair of Computational Mechanics
TU Munich
Boltzmannstr. 15
D–85747 Garching,
Germany
{gee,wall}@lnm.mw.tum.de

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ABSTRACT

The increasing demands of large-scale coupled problems simulations in biomechanics are placing great emphasis on the challenges associated with the efficient solution of the set of potentially nonlinear equations rising from the single fields as well as from their interrelation. Algebraic multigrid methods (AMG) are well known to offer optimal scalability and fast solution to many standard mechanics problems such as elasticity and other diffusion dominated systems.

However, the current trend toward more sophisticated problems, such as fluid structure interaction of blood and vessel wall or air and airway walls considered here, poses challenges to standard algebraic multigrid methods. Especially, the solution of the fluid domain, the potentially severe ill-conditioning of the structural domain due to slenderness, and anisotropies in the choice of grids for both domains have to be considered.

In this presentation we consider recent advances and developments in the field of AMG for fluid and elasticity problems with respect to the challenges mentioned above.

We demonstrate behavior of the presented AMG approaches in the context of large scale fluid structure interaction simulations with monolithic and partitioned field coupling for three dimensional hemodynamics and respiratory mechanics.

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