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A MULTIPHASE APPROACH TO THE CONSTRUCTION OF POD-ROM FOR FLOWS INDUCED BY ROTATING SOLIDS

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Abstract:

This paper deals with the construction of reduced order models (ROM) for the simulation of turbomachinery with imposed rotation velocity. The approach is a follows. First, we extend the NavierStokes equations from the fluid domain to the solid (rotor) domain by the multiphase approach. In this approach, the body velocity is enforced in the solid domain via distributed Lagrange multipliers [**?**]. Second, we build a ROM by a proper orthogonal decomposition (POD) of the resulting multiphase flow. This method consists in (i) constructing an empirical spatial basis for a very small subspace of the solution space, and (ii) projecting the dynamical equations on this reduced basis. By doing this, we benefit from the optimal reconstruction of the solution offered by the POD modes. Third, we use an Uzawa algorithm to impose the prescribed rotation velocity in the solid domain at run time. The novelty compared to previous approaches developed by authors [**?**] consists in considering rotating applications and a new treatment of the rigidity constraint in the solid domain. The proposed method is applied to an academic configuration and proves efficient in the reconstruction of the velocity in both the fluid and solid domains, while substantially reducing the computational cost compared to the full order model.

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