Advances in model order reduction for fluid-structure interaction problems

Gianluigi Rozza*, Monica Nonino*, Francesco Ballarin*, andEfthymiosKaratzas†

* SISSA, mathematics area, mathLab, Via Bonomea 265, 34136 Trieste,Italy
e-mail:grozza@sissa.it, web page: http://people.sissa.it/grozza

†NationalTechnicalUniversity of Athens, 15780, Zografou, Greece

ABSTRACT

Theaim of thisworkis to presentadvances and resultsontheapplication of modelorderreduction to thefield of fluid–structureinteraction (FSI) problems. Wedealwith a transportdominated FSI problem. Thesolutionmanifold has thus a slowlydecayingKolmogorov n-width, and thisdecreasestheeffectiveness of thereducedbasismethodbyincreasingthenumber of basisfunctionsnecessary to build a goodapproximationspace. Wepresent a preprocessingprocedure, carriedout in the offline phase, thatallows to decreasetheKolmogorov n-width of ourproblem. Wepresentsresultsthatshowthecomparison of the performances of theclassical offline stage and the new offline stage of thereducedbasismethod, in three test cases: a time dependent CFD problem (parametric and non-parametric), and a non-parametric time dependent FSI problem. Thisworkiscarriedout in collaborationwith Prof. Y. Maday. Thenwefocuson a partitionedapproach to FSI problems. Weimplementanalgorithmthatisbasedon a semi-implicitcouplingschemewithRobintypeboundaryconditions, takingintoaccountbothan ALEformulation and a geometricalparametrization of thedomain. Finally, weshowresultsconcerningtheapplication of CutFEM to FSI problems: from Stokes to Navier–Stokes and finallyconsidering a fullycoupledmultiphysicsproblem.

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