Model Order Reduction in Contour Integral Methods for parametric PDEs

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We discuss a projection model order reduction method for linear evolution PDEs, which is based on the application of the Laplace transform [2]. The main advantage of this approach consists in the fact that, differently from time stepping methods, like Runge-Kutta integrators, the Laplace transform allows to compute the solution directly at a given instant, which can be done by approximating the contour integral associated to the inverse Laplace transform by a suitable quadrature formula [3, 1]. In terms of the reduced basis methodology, this determines a significant improvement in the reduction phase, like the one based on the classical proper orthogonal decomposition (POD), since the number of vectors to which the decomposition applies is drastically reduced as it does not contain all intermediate solutions generated along an integration grid by a time stepping method. We show by some illustrative parabolic PDEs arising from finance the effectiveness of the method and also provide some evidence that the method we propose, when applied to a simple advection equation, does not suffer the problem of slow decay of singular values which instead affects methods based on time integration of the Cauchy problem.

References

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