MODEL ORDER REDUCTION FOR TIME-DEPENDENT PROBLEMS USING THE LAPLACE TRANSFORM

FERNANDO HENRÍQUEZ AND JAN S. HESTHAVEN

Abstract. We propose a reduced basis method for solving time-dependent partial differential equations utilizing the Laplace transform. Unlike traditional approaches, we begin by applying the Laplace transform to the evolution problem. This transformation yields a time-independent boundary value problem that depends on the complex Laplace parameter.

In the offline stage, we systematically sample the Laplace parameter and solve the underlying set of problems using the Finite Element Method (FEM). Subsequently, we employ Proper Orthogonal Decomposition (POD) on this set of solutions to obtain a reduced basis of significantly lower dimension compared to the original FEM space. This reduced basis is then utilized to solve the evolution problem using an appropriate time-stepping method.

Numerical experiments validate our theoretical claims and demonstrate the advantages of our proposed method, both in terms of accuracy and speed, in comparison to existing approaches.

Keywords: Model Order Reduction; Reduced Basis Method; Laplace Transform.

Mathematics Subject Classifications (2010): 65M6; 65M12; 65M32; 65N12

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Chair of Computational Mathematics and Simulation Science, École Polytechnique Fédérale de Lausanne, 1015 Lausanne, Switzerland

Email address: fernando.henriquez@epfl.ch,jan.hesthaven@epfl.ch