Resolution of the Cauchy problem and uncertainty quantification via the Steklov-Poincaré approach

M.L. Kadri [a]

a. University of Tunis El Manar, National Engineering School of Tunis, Tunisia,
mohamedlarbi.kadri@enit.utm.tn

Abstract

We study the numerical solution of a Cauchy problem . The problem is severely ill-posed. Its theoretical properties have direct consequences on the feasibility of the resolution in an industrial context. A range of methods have been developed in the past decade to adress the ill-posedness of the problem. One method has been selected in this study, namely the Steklov-Poincaré method, that relies on the inversion of a linear system that implies the Steklov-Poincaré operator by a Krylov solver. It was shown that it is possible to compute at very low cost the Ritz values and vectors, that approximate the eigenvalues and vectors of the Steklov-Poincaré operator that are arisen by the righthand side. These Ritz elements are then used to filter the solution. In the present work, we will show that it is possible to use this Ritz decomposition as a reduced order model of the inverse prob- lem, that will make the uncertainty quantification much less costly. in terms of computing time. In particular, in the framework of Gaussian uncertainties, the computation of the uncertainty on the posterior dis- tribution requires to invert the forward operator, which is trivial if this operator is replaced by its reduced form, which is diagonal in the Ritz basis. This procedure has been be numerically illustrated on 2D and 3D test cases.