Towards Predicting the Behavior of Large Dynamic Systems, using Reduced-Order Modeling and Interval Computations

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Abstract

The ability to conduct fast and reliable simulations of dynamic systems is of special interest to many fields of operations. Such simulations can be very complex and, to be thorough, involve millions of variables, making it prohibitive in CPU time to run repeatedly for many different configurations. Reduced-Order Modeling (ROM) provides a concrete way to handle such complex simulations using a realistic amount of resources. However, uncertainty is hardly taken into account. Changes in the definition of a model, for instance, could have dramatic effects on the outcome of simulations. Therefore, neither reduced models nor initial conclusions could be 100% relied upon. In prior work, we have shown that we can use Interval Constraint Solving Techniques to handle models deriving from dynamic systems, either in full-order or reduced-order forms, and handle existing uncertainty. In this work, we propose to further our use of such techniques for dynamic phenomena at the time they unfold to identify their key features and predict their future behavior. This is specifically important in applications where a reliable understanding of a developing situation could allow for preventative or palliative measures before a situation aggravates.