Using Interval Constraint Solving Techniques in Dynamic Systems Behavior Prediction

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Measurements from observation of a natural phenomenon should help us identify important features of it. For instance, characteristics such as the initial size of a population within the observation of any species, the rate of its reproduction [5], the interaction with any competitive species [6], or what the maximum number of individuals it can support is, should be easily identified. Indeed, such features / characteristics can be obtained as the solution of a, sometimes nonlinear, system of equations, which could arise from the discretization of a set of partial differential equations [2] in which measurements have been entered as solutions as particular instants of time.

However, in real life, we do not have exact values as a result of measurements / observations, because measurements always involve some level of uncertainty. As a result, we need to use another strategy than traditional PDE or nonlinear systems solving, to handle the uncertainty. One way of handling uncertainty [3] is to use intervals and a way of handling intervals in the solution of nonlinear systems is via constraint solving techniques [1,4].

In this work, we show how intervals and constraint techniques can be used to identify dynamic phenomena characteristics as well as to predict their future behavior, and what we obtain from doing so. We report and analyze the result of experiments carried out on different PDE problems. In particular, we study the efficiency of our approach subject to the number of measurements and their distance in time.

We discuss the current limitations and challenges of this approach, and draw directions for future work.

References


