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Grid-based Bayesian Estimation Exploiting Sparsity for systems with nongaussian uncertainty THOMAS BEWLEY, UC San Diego, ATI SHARMA, Dept of Aeronautics, Imperial College — We present a new algorithm for Bayesian estimation of nonlinear ODE systems $d\mathbf{x}/dt = \mathbf{f}(\mathbf{x})$ with finite, nongaussian uncertainty. The algorithm presented represents the evolution of the probability distribution in phase space, $P(\mathbf{x}, t)$, discretized on an Eulerian (that is, fixed, Cartesian) grid, and consists of two main steps: (1) Between measurement times, $P(\mathbf{x}, t)$ is marched via careful numerical discretization of the PDE governing its evolution using a Godunov method with second-order CTU correction and an MC flux limiter. (2) At measurement times, $P(\mathbf{x}, t)$ is updated via Bayes' theorem. The key to the efficiency of the new method is a novel technique for leveraging *sparsity* of the probability distribution (that is, leveraging the fact that it is essentially zero almost everywhere in phase space). The absence of a fundamental dependence on a central estimate and the second-order moments of its uncertainty renders the new approach better suited than Kalman-based approaches to nongaussian uncertainty distributions, while the Eulerian discretization of $P(\mathbf{x}, t)$ in the new approach avoids the sticky wicket associated with Lagrangian ("particle"-based) discretizations.

Christopher Colburn
UC San Diego

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