Dynamic Adjustment of Simulation Parameters for Efficient Vehicle Prognostics

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Abstract

Model-based diagnostics and prognostics rely on state estimation and uncertainty management algorithms to produce useful information for system operators and maintainers. This information enables more informed operational decisions, condition-based maintenance, and overall mission safety assurance. Typically, uncertainty is associated with vehicle state-of-health estimation and prediction results because of modeling errors, internal or external sources of noise, and sensor inaccuracy. Probabilistic uncertainty management methods including Sequential Monte Carlo simulation are commonly used to reason about state-of-health estimates and predictions in the presence of these sources of uncertainty. However, such algorithms can be computationally expensive as they require a very large number of samples to obtain a sufficiently accurate quantification of the end of life probability distribution. As a result, highly mobile autonomous systems that leverage the prognostic results for mission-level replanning are often constrained in their processing capability because of these computationally expensive simulation approaches. Therefore, in this paper, we investigate algorithmic methods for dynamically adjusting simulation time step as well as number of samples to achieve highly efficient prognostic results while maintaining results accuracy. Results obtained from simulated flight experiments of an electric unmanned aerial vehicle are presented to verify the efficacy of such algorithms.

1. Introduction
2. Background
3. Problem
4. Results
5. Conclusion