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A Multipurpose Square-Root Consider Covariance Analysis for Linear Filters

Abstract:
Consider covariance analysis is a tool that allows one to “consider” the effects of Kalman filter modeling errors on the accuracy of the filter results. A new form of Consider covariance analysis suitable for application to a wide variety of filtering problems is presented and demonstrated. This analysis enables one to investigate the estimation errors that arise when a filter's dynamics model, measurement model, assumed statistics, or some combination of these is incorrect. Such an investigation can improve filter design or characterize an existing filter’s true accuracy. The new Consider analysis employs a special system formulation and draws on the algorithms of square-root information filtering to provide generality and compactness. Areas of application include incorrect initial state covariance, incorrect, colored, or correlated noise statistics, unestimated states, and erroneous system matrices. Several simple, concrete examples are developed, and the Consider analysis results for these examples are shown to agree closely with Monte Carlo simulations.