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A STUDY OF THE NAVIGATION FOR A SPACECRAFT BY USING MODIFIED ORBIT ESTIMATOR

Abstract

Overview: Development of improved navigation techniques which utilize radiometric (Ranging and Doppler) data acquired from interplanetary tracking stations have received considerable study in several years, as these data types are routinely collected in tracking, telemetry, and command operations. A sequential data filtering strategy currently under study is the orbit estimator, in which most if not all of the major systematic ground system calibration error sources are treated as estimated parameters, along with the spacecraft trajectory parameters. This strategy differs from current practice, in which the ground system calibration error sources are represented as unestimated bias parameters, accounted for only when computing the error covariance of the filter (estimator) parameters. This article reviews the fundamental concepts of reduced-order filtering theory, which are essential for sensitivity analysis and error budget development. The theory is then applied to the development of an error budget for a Venus mission cruise scenario in which enhanced orbit estimation is used to reduce X-band Doppler and ranging data. The filter model is described and error budgets are given for two different strategies: X-band Doppler only, X-band Doppler plus ranging. For this study, the filter model is assumed to be correct representation of the physical world. This paper is described about Reduced-order filter, the observation strategy, and the sensitivity analysis in detail.

Summary : These values graphically illustrate the effects of using different prescribed values of the error source statistics on the estimation errors, with the assumption that the reduced-order filter. A sensitivity analysis was conducted for a reduced-order filter referred to as the enhanced orbit estimation filter. In practice, the enhanced filter attempts to represent all or nearly all of the principal ground system error sources affecting radiometric data types as filter parameters. A reduced-order filter technique were reviewed and utilized to perform the sensitivity analysis, and, in particular, to develop navigation error budgets for two different data acquisition strategies. Error budget performed for the assumed mission strategy revealed that the most significant error source for two data-acquisition strategies studied was spacecraft random nongravitational accelerations, indicating that, for the reference error model, the enhanced filter is most sensitive to mismodeling of small anomalous forces affecting spacecraft. These results suggest that if high-precision navigation performance is to be achieved, the error sources requiring the most accurate modeling are spacecraft nongravitational accelerations error.