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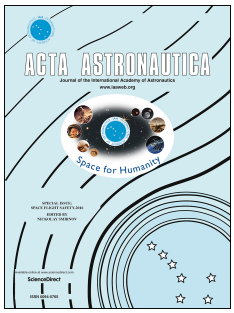

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Uncertain Surface Accuracy Evaluation Based on Non-probabilistic Approach for Large Spacecraft

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Abstract: The influence of the surface shape state upon the performance and function of large spacecraft should be considered in design and analyzed in the extreme space environment. Therefore, in this paper, considering the measurement uncertainties and errors exist in large high-precision spacecraft, an interval surface accuracy evaluation method is proposed based on a non-probabilistic approach. To overcome the limitations of insufficient statistical quantification of uncertain parameters, this paper treats uncertainties as non-probabilistic intervals. The conventional root mean square index is extended to uncertain interval numbers, which can be used to evaluate the surface accuracy with the measurement uncertainties and errors. Moreover, to improve the interval expansion problem, subinterval technology is applied to the uncertainty propagation process for surface accuracy evaluation. As long as the bounds of the uncertainties and errors are known, the interval bound for uncertain surface accuracy can be estimated conveniently by interval analysis. Finally, three engineering examples are separately proposed to evaluate the interval surface accuracy thereby validating the effectiveness and veracity of the proposed method. The result obtained in this paper can be regarded as an interval estimator, offering more detailed evaluations and suggestions for large spacecraft design and analysis than deterministic methods.

Keywords: surface accuracy; uncertainty; interval analysis; root mean square; large spacecraft