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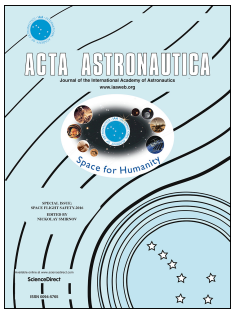

Correlation of spacecraft thermal mathematical models to reference data

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Correlation of spacecraft thermal mathematical models to reference data

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Abstract

Model-to-test correlation is a frequent problem in spacecraft-thermal control design. The idea is to determine the values of the parameters of the thermal mathematical model (TMM) that allows reaching a good fit between the TMM results and test data, in order to reduce the uncertainty of the mathematical model. Quite often, this task is performed manually, mainly because a good engineering knowledge and experience is needed to reach a successful compromise, but the use of a mathematical tool could facilitate this work. The correlation process can be considered as the minimization of the error of the model results with regard to the reference data.

In this paper, a simple method is presented suitable to solve the TMM-to-test correlation problem, using Jacobian matrix formulation and Moore-Penrose pseudo-inverse, generalized to include several load cases. Aside, in simple cases, this method also allows for analytical solutions to be obtained, which helps to analyze some problems that appear when the Jacobian matrix is singular. To show the implementation of the method, two problems have been considered, one more academic, and the other one the TMM of an electronic box of PHI instrument of ESA Solar Orbiter mission, to be flown in 2019. The use of singular value decomposition of the Jacobian matrix to analyze and reduce these models is also shown. The error in parameter space is used to assess the quality of the correlation results in both models.