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A MODEL-BASED SYSTEMS ENGINEERING APPROACH FOR VERIFICATION AND VALIDATION OF COMPLEX LARGE-SCALE SYSTEMS

Abstract

This paper presents a model-based systems engineering methodology to verify and validate thermal engineering performance models of large spacecraft by comparing test measurement data with model predictions. This methodology is based on the formulation of a constrained minimization problem, which can be solved automatically and whose solution represents the optimal thermal performance parameter set. The advantages of this methodology are multiple. First, the solution of the minimization problem removes the thermal model's deficiencies and ultimately provides formal error estimates. Second, the computation of the derivatives is entirely automated. This allows pre-calculating and storing their values, which can be used for multiple executions of this type of analysis during several test campaigns. When a new model becomes available, the derivatives can be quickly updated. Finally, the rapidity with which the analysis can be performed during a project's verification and validation phases can enable considerable reductions in cost and schedule margins. This represents a crucial commodity when testing complex large-scale systems under time and budget constraints. As a case study, this paper will present results for the thermal system of the Integrated Science Instrument Module (ISIM) Electronics Compartment (IEC) of NASA's James Webb Space Telescope.