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SPACE MISSION SENSITIVITY ANALYSIS TOOL USING MACHINE LEARNING

Abstract

Space system is a complex system, which contains a large number of various uncertainties, and their forms of expression are diverse, including randomness, ambiguity, imperfections and so on; these uncertain factors, mainly due to the system composition and its operating environment where contains a large number of randomness, ambiguity, subjective decision-making. In addition, there are complex coupling relationships between these uncertainties, and the simulation of uncertainties is complex. In the whole life cycle of a space mission, especially in the process of demonstration and design, global sensitivity analysis of these uncertainties attracted a large amount of attention by domestic and foreign space agencies and related fields. In order to determine the influence of the uncertain factors in a space mission, many global sensitivity analysis methods are proposed. The input variables are independent in majority of them. However, there are many cases where the input variables are related in practice, and there are few studies on this case. The limitations of the proposed methods are: 1) provide only a comprehensive sensitivity or importance indicator for one input variable; 2) requires a function which is not realistic for a complex system; 3) curse of dimensionality;4) inaccurate for nonlinear systems, and so on. Therefore, we proposed a global sensitivity computation method based on machine learning and Monte Carlo simulation and tried to address the above issues. This method take related uncertainties into account, and will provide the theoretical basis for global sensitivity space mission demonstration and design, and support further system optimization, which is beneficial to make full use of resources and save cost.