Parameter Estimation of ERIS model using Monte Carlo Error propagation Methods

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Linear regression is one popular statistical technique generally adopted to solve parameter estimation problems. Using model and data errors, least square algorithms can be used to find the best fitting parameter solutions. The NASA ERIS model is an FDIR (Fault Detection, Isolation, and Recovery) model for the ARES I rocket. Obviously the ERIS model (a Mathworks Simulink model) contains many model parameters ranging from Boolean flags, discrete variables, and continuous parameters. The entire model currently contains approximately 400 parameters. Dependencies among those, often highly interconnected, variables are very complicated, so identifying key parameters that cause a specific behavior is a critical challenge. Furthermore, uncertainties involved in model and data are essential to understand interactions of integrated model. We are studying these issues using a combination of a Monte Carlo method with n-factor combinatorial parameter variations to yield a good coverage of the parameter space while keeping the number of required simulation runs in a feasible range (several hundreds).

Analyzing the generated data set requires specific algorithms to cluster the data and to analyze the characteristics of clusters. The characteristics of clusters provide insight into interactions of parameters and model behavior. Before generating clusters, a least square approach can be used to understand simulated data set. The sensitivity and error propagation of the simulated dataset has strong similarities with design of experiments. The design of experiments and simulations runs makes a significant impact in variations of results. In sensitivity analysis one looks at the effect of varying the inputs and parameters of a mathematical model on the output of the model itself. Global and local sensitivity analysis uses a least square approach with respect to data set and model as well by varying input and model parameters.

We will present results of initial experiments on the obtained data set. This error analysis can be helpful to understand the behavior of the model and the parameter interactions in the model. Results of this analysis allow engineers and designers to re-evaluate model structure and input parameter intervals.