Paper ID: 31254
poster

SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations (IP)

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REDUCING LARGE VIKING I BASED MARTIAN ENTRY, DESCENT AND LANDING RESPONSE SURFACE METHODOLOGY PRODUCED QUADRATIC MODELS

Abstract

Response surface methodology (RSM), a statistical method exploring the relationships among several descriptive variables and one or more response variables, has been used in quality engineering, process engineering, aircraft engineering, economics, chemical engineering, automotive engineering and design/technique optimization for more than sixty years. Utilizing RSM with large data sets can be complex, time intensive and filled with uncertainty. Large models often contain irrelevant variables affecting their predictability; to address this issue, a variety of techniques are used to reduce them. The Multiple Adjusted R-Squared Reduction Method (MARR-M) technique was developed to reduce large models. This method utilizes a logic algorithm to systematically reduce each regression model in an effort to obtain adjusted R-squared (ARS) values as close to a target ARS value as possible while ensuring that the models remain statistically sound. In support of MARR-M, 37 statistically sound regressions models representing the entry, descent and landing (EDL) process as a test case was developed using RSM. Each model involved 152 variables and variable combinations. A 95% confidence interval of the output data from each model was compared to the 95% confidence intervals of the Mars Viking I based Entry, Descent and Landing (EDL) process. The input values for the simulation and the models were identical Monte Carlo driven inputs. The outputs for 7 of the 37 models showed a percent error between the simulation and models higher than 5% at the lower end of the confidence interval (2.5%) and 2 models of the 37 showed a confidence interval greater than 5% for the upper end of the confidence interval (97.5%), indicating that RSM supported by the MARR-M is a viable means of developing and subsequently reducing models with a large number of variables.