TECHNOLOGY

Multidisciplinary Multi-Objective Sensitivity Analysis

OVERVIEW

Uncertainty in the input parameters of a multi-disciplinary engineering system is unavoidable and results in variations in the outputs at both the system and the subsystem levels of an engineering system which consists of multiple disciplines or subsystems. Such uncertainty can significantly degrade the performance of the system. Examples of such problems can be found in the aerospace, automobile, ship, power tool design and other similar industry.

In any engineering design effort, it is important to determine where to apply limited resources (i.e., cost of new material, conducting survey, new methods, new manufacturing equipment, etc.) at hand to optimally reduce input uncertainty, thereby minimizing output variations in the system. In order to reduce uncertainty in the system efficiently and optimally, it is important to understand the relation between the input uncertainty and output variations for a system. The previous solutions in this area suffer from some serious drawbacks. For example, most of the solutions focus on engineering systems where the uncertainty of input parameters has a presumed probabilistic distribution or systems where only one objective function (or one output for the system and/or subsystem) is considered. Further, these solutions cannot handle multi-disciplinary situations where a complete system consists of different subsystems that interact with each other. As almost all engineering systems are multi-disciplinary and multi-objective in nature, and for many the probability distributions for input parameters not known upfront, the previously proposed approaches are far from being optimal.

To address the above challenges, researchers at the University of Maryland have developed a new technique named “MIMOSA”. This new technique adequately addresses the problem of input/output uncertainty reduction at each level (or subsystem) in a decomposed multi-disciplinary (or multi-subsystem) framework. Using the MIMOSA approach, a designer can identify the sources of uncertainty in the parameters that can be reduced or eliminated in the final design in order to achieve an optimal engineering design. MIMOSA is applicable to the design problems with the following properties: 1) each subsystem can have multiple objective functions and mixed continuous-discrete design variables; 2) subsystems can be fully coupled (i.e., have a two-way connection); 3) interval uncertainty for parameters has been used so that probability distributions, which are difficult to estimate or obtain, are not necessary; 4) functions used to evaluate designs in all subsystems can be black-box simulations (i.e., can be implicit).

For additional information, please contact the Office of Technology Commercialization, University of Maryland College Park, via phone at (301) 405 -3947 or e-mail at otc@umd.edu.

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Additional Information

INSTITUTION

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PATENT STATUS

Patent(s) pending

LICENSE STATUS

Contact OTC for licensing information

CATEGORIES

- Information Technology

EXTERNAL RESOURCES

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