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AN EFFICIENT FRAMEWORK FOR RELIABILITY-BASED MULTIDISCIPLINARY DESIGN OPTIMIZATION USING SYSTEM SENSITIVITY ANALYSIS

Abstract

Considering uncertainty in MDO problems induces a greater level of computational burden in comparison with both the deterministic MDO problems and the non-deterministic single discipline optimization. In multidisciplinary problems in which a multidisciplinary feasibility loop exists, computational burden is even more challenging. In the way of addressing the intensive computational burden of the Reliability-Based Multidisciplinary Design Optimization problems a variety of different approaches have been proposed in the last decade. In this study another effort to encounter with this problem has been presented. A new efficient framework for solving reliability-based multidisciplinary design optimization problems has been proposed using System Sensitivity Analysis (SSA) concept. Employing system sensitivity analysis methodology in the conventional double loop architecture led to an effective change in its framework structure. By resorting and removing some computational loops in it which resulted in significant reduction in computational cost. In this paper the proposed framework has been explained in detail in comparison with the conventional one. In the proposed framework after disciplinary decomposition, the gradient calculation using Global Sensitivity Equation is performed and then the Monte Carlo Simulation (MCS) loop is applied while in the conventional framework the MCS loop is applied after the multidisciplinary convergence and finally the gradient computation loop is the outer loop using finite difference method. Indeed, in the proposed framework using SSA concept make us capable to decompose the couplings in multidisciplinary analysis level and remove the convergence loop needed to obtain a feasible solution in each iteration. Also, the proposed framework, the conventional framework and deterministic optimization have been applied to solve two well-known reliability-based multidisciplinary optimization problems. The comparison study shows that the proposed framework outperforms the conventional framework. Indeed, to achieve the same design optimization results, the proposed framework needs 70 to 80 percent less computational effort in comparison with conventional framework.