An Evaluation of an Analytical Taylor Series Based Software Product (CADOE/ANSYS) for Design Optimization and Probabilistic Analysis

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Despite its substantial benefits, analytical sensitivity analysis based techniques have until now been more popular in the Academia than the Industry for Complex Finite Element Applications [1-2]. One of the reasons for this is the necessity of a strong interaction of the technique with the finite element formulation (and database) - the knowledge of which is usually hidden for the industrial user who typically does not own the source code and formulation of these finite element based analysis. Any general purpose application of these techniques in an industrial setting will therefore rely on commercial software products. ANSYS™ has introduced a new product in collaboration with CADOE™ that uses a discrete sensitivity analysis formulation based on automatic differentiation to compute an analytical Taylor series based response for Finite Element based Deformation Analysis [3-4]. Through this paper, we document the performance of this software product for various applications involving design optimization and probabilistic analysis. These applications include (a) sensitivity analysis (b) propagation of variation (c) deterministic optimization and (c) reliability analysis. Benchmark problems are chosen in order to evaluate the performance of this product against existing best-practice methods for each application. For example – For Deterministic Optimization, Accuracy and Efficiency Comparisons will be made in comparison to existing techniques like (a) Design of Experiments based Response Surface Optimization and (b) Gradient Based Direct Optimization Techniques. For propagation of variation, Accuracy and Efficiency Comparisons will be made in comparison to Fast Probabilistic Methods etc. These studies will be made with respect to shape, sizing and material parameters. Issues related to Mesh Scalability and Noisy Derivatives will be addressed. Finally the Vision for the use of this product for Probabilistic Lifing of Hot Gas Path and Rotor Components for Aircraft Engines will be discussed.

References :

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