

Mode Frontier Framework and its Uncertainty Capabilities in Aeronautics

*Carlo Poloni¹, Alberto Clarich²

¹ Università di Trieste
Dip. Ing. Meccanica
Via Valerio 10, Trieste, Italy
poloni@units.it

² ESTECO srl
Area Science Park,
Pardriciano 99, Trieste
clarich@esteco.com

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ABSTRACT

Robust Design Optimization (RDO) using traditional approaches such as Monte Carlo (MC) sampling requires tremendous computational expense. Performing a RDO for problems involving time consuming CAE analysis may not even be possible within time constraints. In this paper a new stochastic modeling technique based on chaos collocation method is used to measure the mean and standard deviation (σ) for uncertain output parameters. For a given accuracy, chaos collocation method requires far less sample evaluations compared to MC. The efficient evaluation of mean and std. deviation terms using chaos collocation method makes it quite attractive to be used with RDO methods. In this work the RDO of an automotive engine design is performed employing chaos collocation method. The solution strategy is implemented in commercial Process Integration and Design Optimization (PIDO) software tool modeFRONTIER. modeFRONTIER provides a very effective environment to apply multi-objective optimization algorithms to various CAE or in-house analysis and simulation tools. The chaos collocation method is coded in MATLAB scripts that are also invoked through modeFRONTIER. The rest of the paper covers an introduction describing the motivation and challenges. The chaos collocation method is described followed by a description of its application through modeFRONTIER.

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