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Assessing sensitivities of maneuver load alleviation parameters on buckling reserve factors using surrogate model based extended Fourier amplitude sensitivity test

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Abstract

To assess the impact of manuever load alleviation parameter changes on the buckling reserve factor a multidisciplinary high fidelity analysis is necessary. To this end flight maneuver calculation, linear static analysis using a global Finite Element Model and a structural sizing need to be performed. The use of surrogate modeling techniques helps to avoid the time consuming high fidelity analysis but still provides accurate results.

In the frame of global sensitivity analysis the surrogate model is used to apply variance based extended Fourier amplitude sensitivity test. The contribution of input parameter variation of the manuever load alleviation system to the variance of the surrogate model output in terms of buckling reserve factors is measured.

The sensitivity study is performed on the upper cover of a backward swept composite wing and the results are compared to those of the high fidelity analysis. Note that the variation of maneuver load alleviation parameters is nowadays assessed by external loads resulting from the flight maneuver calculation only. The presented approach includes reserve factors and hence provides an insight into the structural response. In this way those maneuver load alleviation parameters are found that affect the structure in terms of buckling reserve factors the most and can be used for future design changes and weight reductions.

References

[1] A. Saltelli, S. Tarantola, K. P.-S. Chan, A Quantitative Model-Independent Method for Global Sensitivity Analysis of Model Output, Technometrics, 41 (1), 39-56, 1999.
[2] G. J. McRAE, J. W. Tilden, J. H. Seinfeld, Global sensitivity analysis - a computational implementation of the Fourier Amplitude Sensitivity Test (FAST), Computers & Chemical Engineering, 6 (1), 15-25, 1982.
[3] S. Marino, I. B. Hogue, C. J. Ray, D. E. Kirschner, A methodology for performing global uncertainty and sensitivity analysis in systems biology, Journal of Theoretical Biology, 254 (2008), 178-196, 2008.
[4] D.W. Stephens, D. Gorissen, K. Crombecq, T. Dhaene, Surrogate based sensitivity analysis of process equipment, Applied Mathematical Modelling, 35 (2011), 1676-1687, 2010.