Uncertainty of FEM Solutions Using a Nonlinear Least Squares and Design of Experiments Approach

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Abstract

Uncertainty in COMSOL Multiphysics® software simulations due to (a) model parameter uncertainties and (b) mesh-induced truncation errors, is estimated using a design-of-experiments approach [1, 2, 3], and a nonlinear least squares logistics fit method [4, 5], respectively. Examples to illustrate both approaches are given using the COMSOL RF Module (in an application of a MRI coil design) and the Structural Mechanics Module (in a stress analysis of a wrench). Significance and limitations of both methods are presented and discussed.

Reference

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[3] J. T. Fong, N. A. Heckert, et al., "A Design-of-Experiments Approach to FEM Uncertainty Analysis for Optimizing Magnetic Resonance Imaging RF Coil Design," Proc. COMSOL Conf., Oct. 8-10, 2014, Boston, MA (2014), http://comsol.com/c/1fa5.

[4] N.R. Draper, and H. Smith, Applied Regression Analysis. Wiley (1966).

[5] C. Forbes, M. Evans, et al., Statistical Distributions, 4th ed. Wiley (2011).

Figures used in the abstract

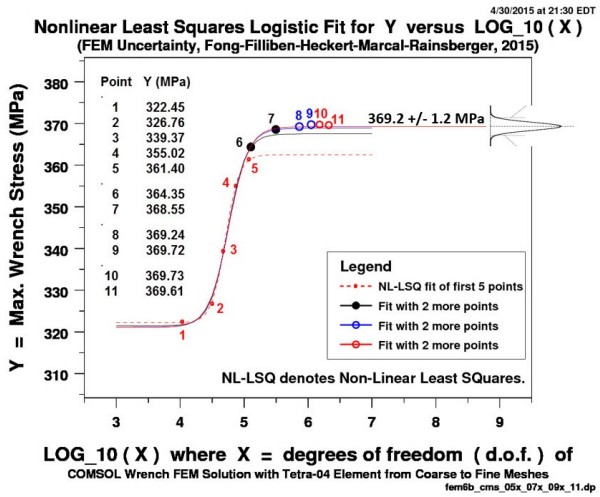

Figure 1: COMSOL results of a stress analysis of a wrench.