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Fatigue probability assessment including aleatory and epistemic uncertainty with application to gas turbine compressor blades

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Abstract

In this work, a new method for fatigue probability assessment is introduced. The method is applied to a bladed disk in a gas turbine for computation of the high cycle fatigue probability for a specific load case. Both epistemic and aleatory uncertainties are modeled. The aleatory uncertainty is of two types: Variable aleatory uncertainty is modeled by use of stochastic variables that influence the problem, including both design variables and stochastic parameters. Physical aleatory uncertainty is modeled by use of a probability that remains even if all stochastic variables are replaced by deterministic values. The fatigue behavior of a material exhibits physical aleatory uncertainty. The results show that the epistemic uncertainty in the modeling of the aero-forcing gives the major contribution to uncertainty in the computed failure probability. The new method is also used to study the influence on the probability of high cycle fatigue that comes from the stochastic variables.

Keywords: Failure probability, fatigue assessment, high cycle fatigue, uncertainty, compressor blade

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