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Reliability High Cycle Fatigue Design of Gas Turbine Blading System using Probabilistic Goodman Diagram

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ABSTRACT

A framework for the probabilistic analysis of high cycle fatigue is developed. The framework will be useful to U.S. Air Force and aeroengine manufacturers in the design of high cycle fatigue in disk or compressor components fabricated from Ti-6Al-4V under a range of loading conditions that might be encountered during service. The main idea of the framework is to characterize vibratory stresses from random input variables (uncertainties such as initial crack size, crack location, loading, material properties, and manufacturing variability). The characteristics of such vibratory stresses will be portrayed graphically as histograms, or probability density function (PDF). The outcome of the probability measures associated with all the values of a random variable exceeding the material capability is achieved by a failure function g(X) defined by the difference between the vibratory stress and Goodman line or surface such that the probability of HCF failure is P(f)=P(g(X<0)). The framework can be used to facilitate the development design tools for the prediction of inspection schedules and reliability in aeroengine components. Such tools could lead ultimately to improved life extension schemes in aging aircraft, and more reliable methods for the design and inspection of critical components.