

ADVANCES RELATING TO FATIGUE CALCULATIONS FOR COMBINED RANDOM AND DETERMINISTIC LOADS

Neil Bishop[§], Paresh Murthy[§], Karl Sweitzer^{§§} and Stuart Kerr[§]

[§]CAEfatigue Limited, Farnham, Surrey, UK.

^{§§}Booz Allen Hamilton, Oakton, VA, USA

ABSTRACT

Techniques for calculating fatigue life from random structural responses were first proposed in the 60's but these early methods were limited to narrow band responses. When used for wide band responses these same techniques could become very conservative. In order to reduce this conservatism much effort was devoted from the 1980's onwards to develop methods that worked more accurately for the wide band situation. Several methods now exist for the wide band case and these typically exist alongside FE based random analysis tools like Nastran, Ansys or Abaqus to take the PSD's of stress response and return the Rainflow cycle count and fatigue damage.

Several problems still exist with today's design methods. Firstly, for large models, these stress transfer functions have to be generated and stored for subsequent use in the fatigue life calculation and these files can be very large. By treating the fatigue life calculation in this way, as a post processing task, the analysis of large models becomes difficult. And secondly, the processing of random stresses within an FE model is problematic, when fatigue life is the required result. And thirdly, no practical way exists to simultaneously combine both random and deterministic loads. This is widely required by the test environment standards like MIL-HDBK-810G.

This presentation will present a review of existing methods, particularly where a design approach has been implemented within an FE environment. This will then be followed by the details of new and novel approaches for [1] more accurately processing the random stresses, [2] for dealing with large models and [3] new methods for combining deterministic and random loads. Several practical examples will be shown.

SUGGESTED THEMES

Dynamics, Fatigue, Durability, Random Response, FEA