

STOCHASTIC MODELING OF MULTIAXIAL FATIGUE AND FRACTURE

YONGMING LIU

Dissertation under the direction of Professor Sankaran Mahadevan

This study proposes a general methodology for mechanical/structural fatigue reliability analysis under multiaxial loading. A new characteristic plane approach is proposed to predict the fatigue crack initiation and propagation life under general multiaxial loading. The proposed fatigue analysis methodology is combined with advanced finite element analysis to predict the fatigue life of railroad wheels. Parametric studies are performed to identify the most important factors affecting the service life of railroad wheels. Uncertainties in material properties, external applied loadings, structural geometries and observed failure profiles are incorporated in the fatigue damage model to evaluate the reliability. A general methodology for stochastic fatigue life prediction is proposed, which combines random process theory, response surface method, design of experiments and the Monte Carlo simulation technique. The proposed methodology is applicable to damage tolerant design and maintenance scheduling of various mechanical and structural components.

Approved \_\_\_\_\_ Date \_\_\_\_\_