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A Method to Numerically Predict the Loading Ratio Dependency of Long Crack Propagation Rates Under Cyclic Loading

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Abstract

The investigation of cyclic crack propagation rates (CPR) for different loading ratios is very elaborate. A multiscale numerical approach to predict high cycle fatigue (HCF) strength for a ferritic-pearlitic steel has been modified to be applicable for the numerical calculation of its cyclic CPR. The original approach involves a series of numerical and mechanism-based analytical models. Microstructural features of the material are statistically characterized for the generation of synthetically representative volume element (RVE) models of the microstructure. A combined isotropic and kinematic hardening model for crystal plasticity is used to include the microdeformation behavior under cyclic loading in the model. The simulation of cyclic loading with numerous of these statistically equivalent RVEs results in fatigue indicator parameter (FIP) fields which differ from one RVE to the other. With regard to the weakest link theory, only the highest FIP in each RVE is extracted for further fatigue calculations. Theses FIPs are distributed by an extreme

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