

Mechanical Engineering Thesis Defense

Time-based Subcycle Fatigue Life Model for Uniaxial and Multiaxial Loading

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Abstract

Mechanical fatigue has been a research topic since quite a long time. It is a complex phenomenon at molecular level. The fact that fatigue failure occurs much below material's yield point, made it much interesting area for research. All the major industries such as automobile, aerospace, medical faces problem of failure of components because of fatigue. So, to understand the physics behind fatigue failure became an important research topic. Fatigue failure is characterized by crack initiation and then crack propagation to finally fracture the material. If we could model the fatigue crack growth and fracture point mathematically, then it would save lot of resources and would assure the structural integrity of given component. Many such mathematical models were published to calculate fatigue crack growth for Constant Amplitude Loading, but most of the time the applied loads are variable in nature. So, to address this problem a mathematical model which will predict fatigue life in terms of time history is needed. This research study focuses on improving previously developed subcycle fatigue crack growth model also known as small time scale model which works well in Paris regime. In the first part, focus has been given on estimating threshold point using subcycle model by applying load shedding techniques. Later subcycle model has been modified to include fatigue crack growth in threshold region. In the second part of this research study, the concept of Equivalent Initial Flaw Size (EIFS) and fracture mechanics approach has been used to compute fatigue life for Constant as well as Random Amplitude Loading. Further the model has been extended to compute the fatigue life under Mixed Mode Loading (Mode I & Mode II). Standard material properties are used to calibrate the model parameters. The fatigue life results were validated using available open literature data as well as experimental testing data. The subcycle model can be used to calculate fatigue life in case of HCF and LCF, which is suggested as a future work for this research study.



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Zoom Link: <https://asu.zoom.us/j/85744256562>