NUMERICAL ANALYSIS OF FATIGUE DAMAGE BEHAVIOR IN FIBER COMPOSITES UNDER DIFFERENT BLOCK LOADING CONDITIONS

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During their lifetime, practically applied fiber composite structures, like components of aircrafts or wind energy turbines, are usually subjected to cyclic loading with variable load amplitudes and arbitrary load orientation. For a cost-oriented design process of complex structures, the use of computationally efficient and detailed fatigue damage tools is essential when safety-relevant design concepts such as damage tolerance are used.

Krüger and Rolfes [1] have proposed a progressive fatigue damage model (FDM) for unidirectional fiber composites, which is potentially applicable for large structures. The FDM relies on a layer- and energy-based approach, and it is capable of including basic fatigue phenomena, such as load sequence effects and stress redistributions. Recently, the FDM has been successively upgraded and validated for various applications, for instance for damage analyses under different stress ratios [2] or inhomogeneous stress states [3].

The current contribution focuses on the extension and application of the FDM for damage prediction under variable block loading conditions [4]. First, the model is consistently extended to consider damage evolution under arbitrary block loading patterns. Herein, the model contained damage evolution curves are deliberately updated. Second, lifetime predictions of coupon specimens are performed applying different block loading patterns. Finally, the extended FDM is used for damage analysis on different practical applications. The predictive capabilities of the FDM are evaluated by comparison with experimental findings from literature.

References

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