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A CYCLIC COHESIVE ZONE MODEL FOR TRANSIENT THERMOMECHANICAL LOADING

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In recent years, a class of cyclic cohesive zone models (CZMs) based on damage evolution equations were developed and applied to model fatigue crack formation and propagation in parts subjected to cyclic loading. As in the established CZMs for monotonic loading conditions, the tractions across the cohesive zone are reduced proportionally to the damage irreversibly accumulated in every cycle reflecting degradation of the material. In parts subjected to thermomechanical cyclic loading, especially with large temperature gradients, the fatigue crack formation and growth may additionally be altered by redistribution of the coupled thermomechanical fields caused by degradation of thermal conductance across the damaged zone as well as by the thermal contact of the newly formed crack faces. To model the described behaviour, the coupling between the thermal and the mechanical fields must be included into a CZM.

In this work, the cyclic CZM proposed in [1] is extended onto the case of transient non-isothermal loading conditions, along similar considerations given in [2]. In addition to relations describing the heat flux across the damaged part of the cohesive zone, the thermal conductance across the contact zone of two interacting bodies, as proposed in [3], is also considered. In this way, the implemented contact formulation of the thermomechanical CZM allows to describe evolving tractions and heat flux across the cohesive zone both in open and closed states. To accelerate simulations, the implementation also includes the cycle jump technique based on direct integration of the damage evolution equation, suggested in [4].

In this contribution, an outline of the implemented thermomechanical cyclic CZM and aspects of the utilized cycle jump technique, as well as the simulation results of a multi-layered specimen subjected to rapid thermal cycling will be given.

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