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Crack Propagation Simulation using communicating user subroutines to predict complex crack growth.

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The simulation of crack propagation in adhesive joints and adjacent parts, in order to design and develop fatigue resistant adhesive joints, is still a challenge today. Thus, many approaches are being developed for different applications. Cohesive zone elements are already implemented into commercial software but often extended through user defined subroutines. For this work a user-defined material based on a crack growth model, which describes the cohesive stress and damage in the adhesive [1] is used. A second user defined subroutine developed at the HAW Hamburg is used for intralaminar damage. The described composite joint is modelled on a mesoscopic level with one layer of cohesive elements and one layer of solids per lamina ply to enable fibre failure and delamination under fatigue loading. Both subroutines are implemented in ABAQUS and linked to exchange information between the material models.

The aim of the communication is to transfer the good simulation results achieved with the individual user subroutines to a complex damage scenario of more realistic nature. These scenarios require the crack being able to jump through fibre layers or to initiate delaminations due to matrix damage in adjacent composite layers.
In this study the simulation results of the same physical problem simulated with and without the communication as well as with only a single user subroutine are compared against each other to demonstrate the benefits and drawbacks of the communication between user subroutines in crack propagation simulations.

REFERENCES

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