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Multi-objective optimization of material model parameters of an adhesive layer by using SPEA2

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Abstract

The usage of multi material structures in industry, especially in the automotive industry are increasing. To overcome the difficulties in joining these structures, adhesives have several benefits over traditional joining methods. Therefore, accurate simulations of the entire process of fracture including the adhesive layer is crucial. In this paper, material parameters of a previously developed meso mechanical finite element (FE) model of a thin adhesive layer are optimized using the Strength Pareto Evolutionary Algorithm (SPEA2). Objective functions are defined as the error between experimental data and simulation data. The experimental data is provided by previously performed experiments where an adhesive layer was loaded in monotonically increasing peel and shear. Two objective functions are dependent on 9 model parameters (decision variables) in total and are evaluated by running two FE simulations, one is loading the adhesive layer in peel and the other in shear. The original study converted the two objective functions into one function that resulted in one optimal solution. In this study, however, a Pareto front is obtained by employing the SPEA2 algorithm. Thus, more insight into the material model, objective functions, optimal solutions and decision space is acquired using the Pareto front. We compare the results and show good agreement with the experimental data.

Keywords: Multi-objective optimization, parameter identification, micro mechanical model, adhesive, CZM.