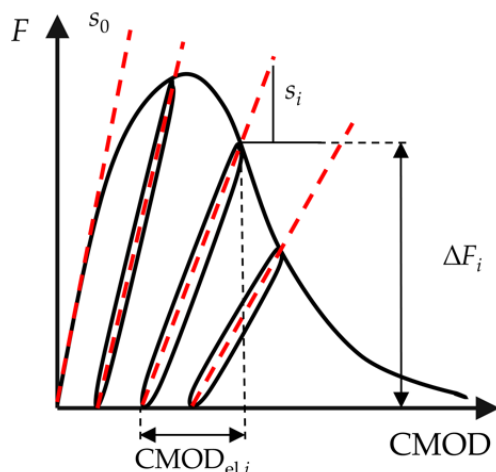


Jörg Schröder

“Phase-Field Modeling of Fracture in Steel Fiber Reinforced High-Performance Concrete”

High-performance concrete (HPC) is one of the most innovative types of concrete. HPCs are very diverse in their composition and therefore differ from classic types of concrete. Fiber-reinforced HPCs have a significantly higher strength and energy absorption capacity than conventional concretes. Fiber-reinforced HPC shows a pseudo-ductile material behavior during failure, mainly characterized by complex fiber-matrix interactions. We propose a phenomenological material model to discuss the influence of reinforced fibers, represented by orientation distribution functions (ODF), on the failure process of HPC. Therein, an additive type macroscopic energy function is formulated, superimposing the models of one-dimensional elasto-plasticity for the steel fibers and an elasto-plastic phase-field fracture model, which can predict the nonlinear behavior of HPC during low-cycle fatigue. We apply the pressure-sensitive Drucker-Prager yield criterion as a basis for pure concrete behavior. A phase field model is used to regularize the softening behavior of the material; otherwise, we can expect a pathological response in the finite element method. Two different data-driven degradation functions are calibrated to model the asymmetric tension-compression behavior of HPC. Three-



Jörg Schröder is Professor of Mechanics and was Vice-Rector for Research at the University of Duisburg-Essen from 2011-2015 and 2018. From 2020-2023 he was the president of GAMM and is now the vice-president until 2025. He is a member of the Academy of Sciences and Literature Mainz, the German Academy of Science and Engineering „acatech“ and a senator of the German science foundation (DFG). Furthermore, he was the spokesperson of the DFG Research Unit 1509, “Functional Materials at Multiple Scales, Continuum Modeling and Experimental Characterization” and of the DFG Priority Programme 1748, “Reliable Simulation Techniques in Solid Mechanics”. He is Editor-in-Chief of „Archive of Applied Mechanics“. His areas of research are computational mechanics, continuum mechanics, and constitutive modeling: polyconvexity, mixed finite elements, multiscale modeling (FE²), coupled problems, ...

point bending experimental tests at low-cycle using notched beams are performed, and the experimental load-CMOD (crack mouth opening displacement) curves are used to calibrate the proposed numerical model. ODFs approximate different distributions and orientations of reinforced fibers. The accuracy of the proposed numerical model is verified by comparing the degradation of stiffness in numerical and experimental results.