

Construction of Statistically Similar RVEs for the Direct Micro-Macro Simulation of Multiphase Steels

Daniel Balzani

TU Dresden, Institute of Mechanics and Shell Structures
August-Bebel-Str. 30, 01219 Dresden, Germany, Ebene 3, Zr. 03-018
E-mail: daniel.balzani@tu-dresden.de

Abstract

Advanced High Strength Steels (AHSS) are increasingly used in the industry due to their excellent strength and formability properties enabling weight savings. This wide class of steel is characterized at the microscale by a heterogeneous arrangement of different phases, e.g. ferritic/bainitic matrices with martensitic/austenitic inclusions in DP and low-alloyed TRIP steels. These micro-heterogeneities lead to a complex macroscopic material behavior whose phenomenological modeling is difficult. Thus, direct micro-macro calculations often referred to as FES² can be applied to not only reliably obtain the macroscopic material response but also to include microscopic physical phenomena into the simulation. In this contribution different aspects of AHSS simulations based on this two-scale approach are discussed.

The main problem of such simulations, however, is the tremendous demand regarding the required high-performance computing infrastructure. Therefore, methods to reduce the computing times are essential. In this context the construction of statistically similar RVEs (SSRVEs) may be beneficial. These artificial SSRVEs are characterized by a significantly reduced morphological complexity as the real microstructure enabling a less demanding discretization and thus, to a significant reduction of computing time and memory. They are obtained by minimizing a least-square functional taking into account differences of statistical measures computed for the real microstructure and for the SSRVE. In order to capture sufficient statistical information regarding the microstructure morphology, measures of higher order, such as the spectral density, the lineal-path function or Minkowski valuations, are required and discussed in the talk.