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GENERATION OF UNIDURECTIONAL COMPOSITE STOCHASTIC VOLUME ELEMENTS FROM MICRO-STRUCTURAL STATISTICAL INFORMATION

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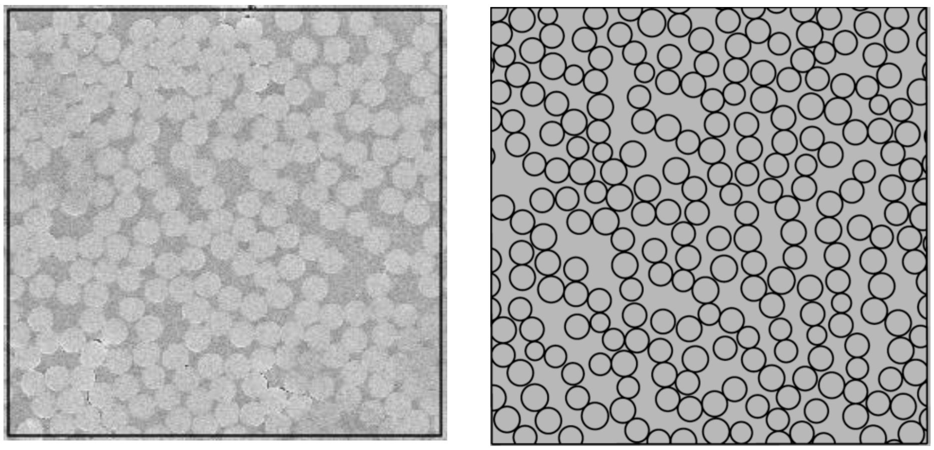
Abstract. The purpose of this work is to generate Stochastic Volume Element (SVE) of unidirectional composites using statistical information obtained from imaging technique in order to study the effect of the micro-structure uncertainty on the meso-scale behavior.

When considering a homogenization-based multiscale approach, the material properties are obtained at each integration point of a macro-structure from the resolution of a micro-scale boundary value problem. When the separation of scales holds, the macro-point is viewed at the micro-level as the center of a Representative Volume Element (RVE). However, for composite materials which suffer from a large scatter in their constituent properties and microstructure, the separation of scales does not always hold, in particular at the onset of failure, and structural properties exhibit a scatter.

In order to predict this scatter, Stochastic Volume Elements (SVE) [1, 2] of unidirectional fiber composite materials should be built from experimental measurements, see Fig. 1(a). Toward this end, statistical functions of the fibers features such as radius, the closest neighboring distance etc. [3] are extracted from several SEM images to generate statistical functions of the micro-structure. The dependent variables are then represented using the copula framework, allowing generating micro-structures, see Fig. 1(b), using an



(a) SEM image (b) Generated SVE

Figure 1: Generation of SVEs using SEM data

inclusions additive process. Simulations on the generated SVEs are then used to extract the probabilistic meso-scale stochastic behavior.

In the future the extracted behaviors will be used to build a stochastic model of homogenized properties based on Mean-Field-Homogenization in order to predict statistical macro-scale behaviors and in particular the failure onset.

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