Master Thesis Project at the Division of Material and Computational Mechanics

Multi-scale modeling of the mechanical behavior of Short Fiber Reinforced Bio-composites via orientation averaging (SFRB_2)

Background

Recent decade has seen considerable developments of bio-composite materials. Renewable resources, environmentally friendly production and disposal at the end of their life, being less expensive compared to glass and carbon fiber composites and having reasonable structural properties could be mentioned as the advantages of these materials. Short fiber reinforced bio-composites have interesting mechanical properties such as high strength/density and high stiffness/density ratios. Besides, the manufacturing process of these materials are quick and low cost.

A modeling approach which can be used for Short Fiber Reinforced Bio-composites (SFRB) is the orientation averaging approach. In this approach, the mechanical behavior of a Unit Cell (UC) including a single fiber (Fig.1 (b)) is obtained and based on the micro-structural orientation of the fibers, the mechanical response of the SFRB is obtained.

Purpose and project description

The idea in this master projects is to quantitatively model the mechanical behavior of a bio-composite made from short cellulose fibers and Poly-Lactic-Acid (PLA) using computational homogenization. For the matrix material (PLA) it is needed to implement an elasto-viscoplastic model in Abaqus. The model is already implemented in another open source FE code and routines can be provided to the student. Material properties should be quantified for the matrix material. The student will be guided through the process. FE simulations on a UC will be conducted and fiber orientations will be obtained by micro-structural characterization. Finally, the mechanical response of the SFRB will be obtained using the UC response and fiber orientations. The project will be executed at the department of Industrial and Materials Science (IMS) within the Division of Material and Computational Mechanics.

Student background

This project is suitable for a student who is interested in computational mechanics and the Finite Element Method. Students with strong interest and good experiences in programming are encouraged to apply.

Remark: This project, Short Fiber Reinforced Bio-composite (SFRB_2), could be preferably performed with another master project (SFRB_1) as a collaboration between two master students.

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