

Institut für Mechanik der Werkstoffe und Strukturen

FoB Struktursimulation und Ingenieurholzbau

Linking Mechanics to Form-Finding of Plant-Based Bio-Composite Structures (Subproject 8 of SFB Advanced Computational Design)

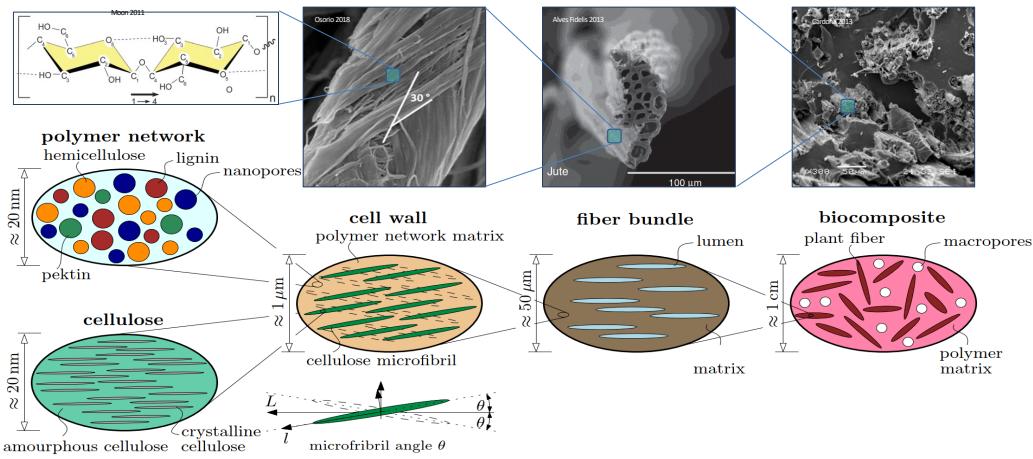
Motivation

Plant-based bio-composites are sustainable and high-performance building materials, with the potential to reduce the usage of non-renewable (petroleum-based) materials in the future. Models for a sound mechanical characterization are not available yet.

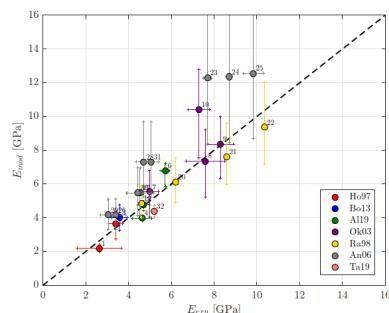
Goals

- Development of a multiscale model, able to link microstructural characteristics to the macroscopic material behavior
- Macroscopic stiffness and strength estimates by using continuum micromechanics as well as finite element based concepts
- Derivation of meta-models for these material systems and implementation of them into computational design tools

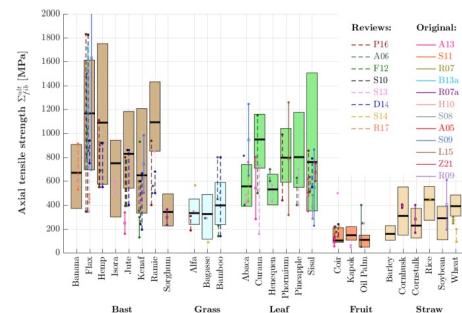
Micromechanical multiscale model for plant-based bio-composites



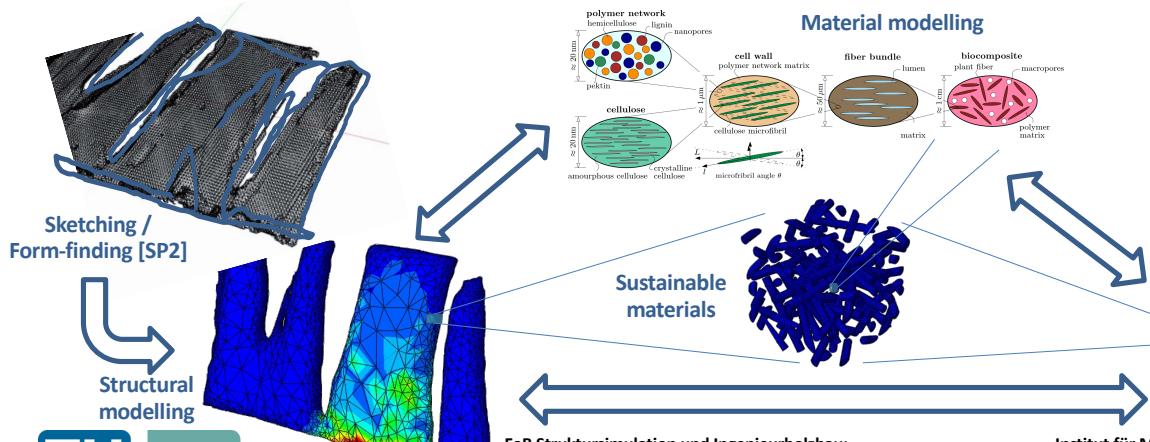
→ Homogenization of composite stiffness
including effects regarding fiber-matrix interface



→ Homogenization of fiber tensile strength
assuming failure of crystalline cellulose

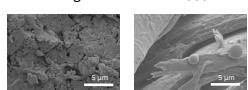


Links – from micromechanics to structural feedback



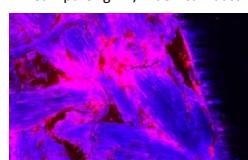
Material characterization

Scanning electron microscopy

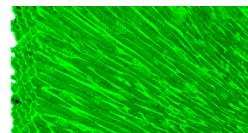


Fluorescence Microscopy

Red = pure lignin / Blue = saw dust

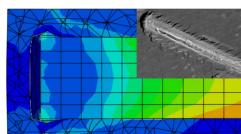


micro-CT

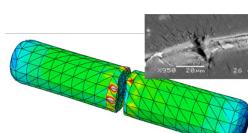


Finite Element Simulations

Interface failure



Fiber failure



Virtual reality / Haptic feedback [SP5]

