Project description

Development of a multi-physics biofilm model incorporating biofilm mechanical and structural characteristics from multi-dimensional imaging datasets acquired by means of optical coherence tomography

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Contact: Dr. Michael Wagner
Luisa Gierl

Partner: Institute for Computational Mechanics
Technical University of Munich
Prof. Dr.-Ing. Wolfgang A. Wall
Dr.-Ing. Lena Yoshihara

Biofilms are sessile communities consisting of microorganisms developing on interfaces in aqueous environments. The mechanical properties of a biofilm are determining its fluid-structure interactions and stability, e.g. at raised shear stress levels. Thus, for biofilm control there is a need for better understanding the mechanical behavior of these aggregates.
To correlate the biofilm structure with the mechanical properties, we are cultivating and evaluating biofilms of *Bacillus subtilis* in minifluidic flowcells. Development and structure are monitored *in situ* and non-invasively by means of optical coherence tomography (OCT). OCT is further applied to follow structural changes under modified shear stress conditions in real-time. Therefore, material properties such as the shear modulus are derived. Obtained image data is used by the project partner at TU Munich, Institute for Computational Mechanics (LNM) as structural templates for the development of an advanced biofilm model. By use of an inverse analysis, the model should be capable of reflecting material characteristics and their distribution. Features reaching beyond the experimental evaluation or that are inadequate described to date should then become available by feeding the model with imaging information monitoring biofilm deformation.

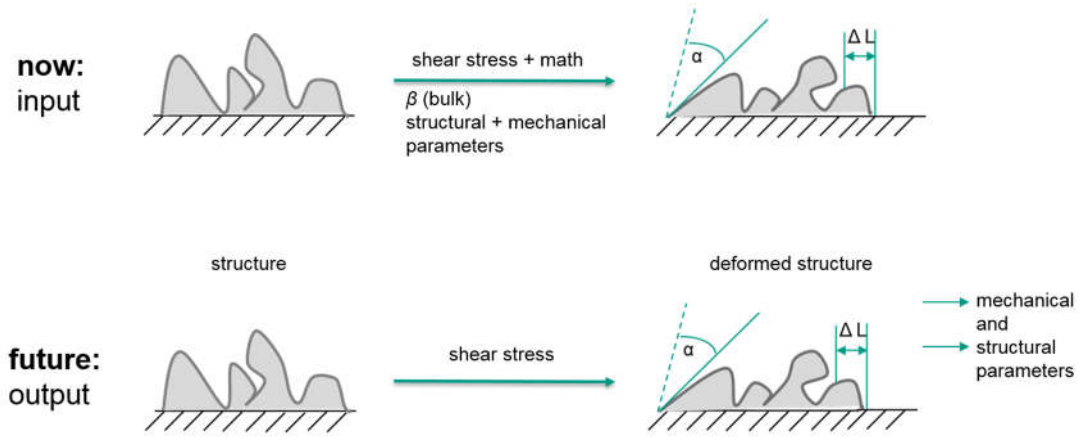

Figure 1: Biofilm modeling today and by use of an inverse analysis approach. Recently, structural and mechanical parameters generated experimentally are necessary to calculate biofilm behavior in terms of modeling. In future, mentioned and further important parameters can be obtained out of the model vice versa by application of an inverse analysis approach. Furthermore, predictions on biofilm behavior under different cultivation conditions can be fulfilled.