Evaluation of biofilm mechanical properties using optical coherence tomography (OCT) and fluid-structure interaction simulations

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Evaluation of material properties of biofilms is a challenging task and has been done either by mechanical testing or from image analysis methods. Mechanical testing is hard to conduct on intact biofilms. Techniques such as rotational rheometry allow the determination of average material properties, but destroy the biofilm structure during the measurement. On the other hand, image analysis from bright field microscopy or optical coherence tomography (OCT), allows to extract material properties from non-destructive structural deformation, but calculation depends on assumption of e.g. wall shear stress.In this study, we found that data of OCT can be used in computational fluid-structure interaction simulations to easily access biofilm mechanical properties, such as the Young's modulus *E*. Biofilm structures were extracted from OCT scans, following biofilm deformation caused by hydrodynamic loading. The 2D or 3D geometries of the undeformed biofilm structures were implemented in a computational fluid dynamics model using a finite element software (COMSOL Multiphysics). Simulations of the experimental conditions allowed to obtain an adequate estimation of the flow field and shear stress acting on the biofilm structure. To fit simulated deformation to real deformed biofilm, the Young's modulus was used as sensitive parameter. The study showed that under a range of different flow conditions, values for *E* were found between 70-325 Pa. The outcome of the study showed that the Young's modulus should not be assumed a constant parameter. Coupling non-destructive experimental techniques to appropriate computational modeling, is well suited for the study of biofilm material properties.