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Analysis of fluid-solid mixture models of biofilm spread

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We investigate multiphase systems of conservation laws describing bacterial biofilm spread on surfaces [1, 5, 6]. These systems are set in moving domains, which brings in numerous challenges. A quasistationary approximation allows us to remove time dependence from the transport and concentration submodels [3, 4]. We stabilize the quasistationary displacement-pressure submodel by deriving an additional equation for the velocity. This closure involves an additional parabolic problem set in a moving domain. We establish an existence, uniqueness and stability theory for parabolic problems with moving domains whose boundaries move according to specific vector fields [3, 2]. Fixed point arguments allow us to construct a solution to the full system of coupled submodels. These results assume that the motion of the boundary of the biofilm is prescribed. Addressing the free boundary problem, which couples this system to an additional integrodifferential equation for the motion of the biofilm boundary, remains a challenge.

References

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