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*Bacteria Yelling: A mathematical view on inter-colony communication in biofilm systems with slow background flow*

Abstract:

Bacterial biofilms are structured microbial populations that are attached to immersed interfaces. Quorum sensing has been described as mechanism of bacterial communications: The bacteria produce and sense continuously signaling molecules and undergo locally a rapid gene-upregulation if the signal concentration reaches and passes an a priori known critical value. We describe this process by double degenerate diffusion reaction system for the dependent variables down and up-regulated cell densities, growth promoting nutrients and signaling molecules. We prove the well-posedness of this model. In fact, this is the first representative of this class of equations for which we can also show uniqueness (existence of solutions to this type of problems has been established for a number of years). We study the behavior of the solutions of this model and of an extended version in computer simulations, focusing on the quorum sensing communication between neighboring colonies. We will restrict ourselves to the case of slow background flows where molecule transport is neither diffusion nor convection dominated and we will focus on the role of quorum sensing for bacteria to switch from an initial colonisation mode of growth to a mode of growth where the emphasis is on producing protecting extracellular polymeric substances.