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COMPUTING PHENOTYPE AND STRUCTURAL PATTERNS ON BACTERIAL BIOFILMS

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Bacterial communities attached onto surfaces often show behaviours related with self-organization processes at cellular levels (i.e spreading, shaping, etc.) that are poorly understood [1]. In some bacterial strains, a chemical cell intercommunication is established between the individuals of a microcolony to develop large bacterial clusters with specialized cells spatially distributed to optimize the survival chances of the colony [3]. However some studies have demonstrated that the mechanical interaction between differentiated cells affects their internal distribution and induce other physical phenomena, such as osmotic pressure gradients, that affect the shaping of the colonies and their spreading patterns [2, 8].

In this work we introduce a simple computational framework to study the interplay between mechanical and cellular processes in the development of a *Bacilus subtilis* biofilm, a typical bacterial strain widely studied [1, 2, 3, 4], onto an agar gel - air interface. A discrete system is implemented to describe the dynamics of an initial cell cluster by using a hybrid approach. Bacteria uptake nutrients and oxygen from agar-gel surface to reproduce and deform according to Föppl-von Karman equations [5], which governs stress and strain fields in the colony.

The main processes related to individual cell behaviour (reproduction, differentiation etc.) are computed using an stochastic approach [6]. Physical continuous fields (concentration of chemicals, stress and strain, etc.) are governed by continuous PDEs. Both descriptions feed back each other during the simulation to reproduce the dynamics of the bacterial biofilm. Geometric patterns and cellular distributions similar to those found in the experiments are reproduced.

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