Modelling pattern formation in competitive bacterial biofilm growth

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Mechanical and genetic heterogeneity of bacteria are known to be important factors in biofilm growth. These inhomogeneities can lead to cell sorting, sector formation and gene surfing which increase the evolutionary fitness of otherwise disadvantaged sub populations. Range expansion experiments and modelling have been used to study the influence of genetic drift with or without selective advantage [1].
Zöllner et al. introduced bacterial strains with different tunable mechanical interactions and division times to study their influence on colony growth and range expansion [2,3]. They used a strong interacting fast growing strain and a slow growing weak interacting strain where the weak interacting strain got sorted to the perimeter of the colony and therefore could surf and outgrow the faster growing strain.

We study this setup with different interacting strains as a lattice gas model with dividing, swapping and pushing particles. We reproduce the pattern formation observed and find in accordance with these experiments that strains with even 1.9 faster division time cannot outgrow the weak interacting population which surf at the frontier of the expanding colony.

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