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Dynamics of microorganisms with autochemotactic interactions
JOHANNES TAKTIKOS, Technical University Berlin, Germany, VASILY ZABURDAEV, Harvard University, HOLGER STARK, Technical University Berlin, Germany — Our work aims at the description of the early stage of bacterial biofilm formation. In light of this, we model bacteria as self-propelled particles that move on a surface with constant speed and whose directions of motion diffuse on the unit circle. Individual cells communicate by autochemotaxis, so they follow the gradient of a chemical which is produced by the microorganisms themselves. We investigate how the autochemotactic coupling influences the mean squared displacement of a single particle and show that the long-time dynamics is diffusive. We present theoretical predictions for the diffusion coefficient and compare them to numerical results. To incorporate the size of bacteria, we model them as disks that experience a harmonic repulsion force when they start to overlap. Our repulsion mechanism for particles in contact assumes a linear relationship between force and velocity. For such a soft model microorganism, we present numerical results on two-particle collisions and study the cluster formation in a multi-particle system.

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