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Cauliflower shapes of bacterial clusters in the off-lattice Eden model

Tuesday, 20 May 2025 10:05 (1h 30m)

We will present our results of an off-lattice Eden model used to simulate the growth of bacterial colonies in the three-dimensional geometry of a Petri dish [1]. In contrast to its two-dimensional counterpart, our model takes a three-dimensional set of possible growth directions and employs additional constraints on growth, which are limited by access to the nutrient layer. We rigorously tested the basic off-lattice Eden implementation against literature data for a planar cluster. We then extended it to three-dimensional growth. Our model successfully demonstrated the non-trivial dependency of the cluster morphology, non-monotonous dependency of the cluster density, and power law of the thickness of the boundary layer of clusters as a function of the nutrient layer height. Moreover, we revealed the fractal nature of all the clusters by investigating their fractal dimensions. Our density results allowed us to estimate the basic transport properties, namely the permeability and tortuosity of the bacterial colonies.

[1] Szymon Kaczmarczyk, Filip Koza, Damian Śnieżek, and Maciej Matyka,
Cauliflower shapes of bacterial clusters in the off-lattice Eden model for bacterial growth in a Petri dish with an agar layer (accepted in Phys. Rev. E)

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References

<https://arxiv.org/abs/2406.20011>

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