Swimming microorganisms near circular obstacles and boundaries M. Bahrs, Bachelorarbeit, Universität Potsdam (2013).

The effects of restricted geometries on the swimming behavior of the polarly flagellated soil bacterium Pseudomanas putida were examined. Videomicroscopy and image analysis techniques were used to measure single-cell motility parameters. We used microfabricated channels measuring 30 mm in length, 300 μm in width, and 5 μm in height. To study the influence of confinement and complex geometries on the motility behavior of bacteria we introduced cylindrical obstacles into the channel ranging from 25 μm to 100 μm in diameter. They were arranged in a hexagonal lattice with obstacle distances ranging from 5 μm to 20 μm. The results show that the structured microfluidic environment can be used as a simple means to observe and quantify the movement and navigation of bacteria through geometrically heterogeneous environments. We found that obstacles have an effect on the swimming motility when no external flow is applied. It could be shown that by varying obstacle size and distance, the average speed changes significantly. Additionally, speed statistics exhibit a bimodal distribution similar to earlier observations. We successfully recover the mean square displacement and the curvature of the trajectories of swimming cells. The results indicate a dependence on obstacle size and distance. Furthermore, more curved trajectories are found than in bulk fluid corresponding to a decrease in the mean square displacement.