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Single cell motility and trail formation in populations of microglia¹

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Microglia are a special type of glia cell in brain that has immune responses. They constitute about 20 % of the total glia population within the brain. Compared to other glia cells, microglia are very motile, constantly moving to destroy pathogens and to remove dead neurons. While doing so, they exhibit interesting body shapes, have cell-to-cell communications, and have chemotactic responses to each other. Interestingly, our recent in vitro studies show that their unusual motile behaviors can self-organize to form trails, similar to those in populations of ants. We have studied the changes in the physical properties of these trails by varying the cell population density and by changing the degree of spatial inhomogeneities (“pathogens”). Our experimental observations can be quite faithfully reproduced by a simple mathematical model involving many motile cells whose mechanical motion are driven by actin polymerization and depolymerization process within the individual cell body and by external chemical gradients.

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