Abstract: A model of rippling behaviour in *Myxococcus xanthus*

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Bacterial populations provide interesting examples of how relatively simple signalling mechanisms can result in quite complex behaviour of the colony. A well studied example of this phenomena can be found in Myxobacteria; cells can coordinate themselves to form intricate rippling patterns and fruiting body formations using localised signalling. Our work attempts to understand and model this emergent behaviour. We develop a simulation model based on the Cellular Potts Model (CPM) which attempts to mimic and explain ripple formation.

Myxobacteria are a family of soil dwelling, Gram-negative bacteria characterised by a complex life cycle [1, 3]. Under starvation conditions cells undergo a process of morphogenesis in a series of distinct phases culminating in the formation of a fruiting body; a large multicellular aggregate of approximately 100,000 cells.

Here we present a mathematical and computational approach to examine rippling in myxobacteria to determine how rippling manifests itself and the mechanism of c-signal exchange. A number of current models show rippling however they are restrictive and exercise a lot of control over cell motion making ripple formation highly probable. We seek to show that ripples should form spontaneously within a population by examining the following properties: cell stiffness, length-to-width ratio, sensitivity to c-signal and the localisation of c-signalling regions. We suggest that signalling needs to be localised to cell poles however it is not sufficient to have sensitive regions only at the very tip, they must partially extend down the cell body.

We use a discrete stochastic model based upon a Cellular Potts Model (CPM), which has recently been used to model swarming behaviour in myxobacteria [2, 5, 4]. Our model uses cells made of connected segments so that with appropriate energy terms we can create semi-flexible rods to realistically capture myxobacterial cell movement.

References

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