

DIRECTION-DEPENDENT TURNING LEADS TO ANISOTROPIC DIFFUSION AND PERSISTENCE

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Cells and organisms follow aligned structures in their environment, a process that can generate persistent migration paths. In particular, movement of cells through tissues is critical during both healthy and pathological processes. Embryonic development relies on cells migrating from origin to final tissue destination, repair processes necessitate movement of fibroblasts and macrophages into the wound site, and migration of cancerous cells, unhappily, leads to tumour invasion and metastasis dissemination. Consequently, there is clear reason to understand the factors that guide cells with one such process, contact guidance, defining the movement of cells along linear/aligned tissue features, for example, blood vessels, white matter brain fibres, or the collagen fibres of connective tissue.

Kinetic transport equations are a popular modelling tool for describing biological movements at the mesoscopic level, yet their formulations usually assume a constant turning rate. Here we relax this simplification, extending to include a turning rate that varies according to the anisotropy of a heterogeneous environment. In particular we extend the very well known transport model for contact guidance proposed by Hillen [2] and we extend known methods of parabolic and hyperbolic scaling. We apply the results to cell movement on micro-patterned domains also through numerical simulation of the transport model. We show that inclusion of orientation dependence in the turning rate can lead to persistence of motion in an otherwise fully symmetric environment, and generate enhanced diffusion in structured domains.

REFERENCES

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- [2] Hillen, T. (2006) M5 mesoscopic and macroscopic models for mesenchymal motion. *J. Math. Biol.* 53(4), 585–616.