Plasticity in the Networks that Comprise and Control Cell Migration

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Cell migration is a dynamic and heterogeneous phenomenon that emerges from a complex adaptive system spanning multiple spatial and temporal scales. We seek to understand the nature and role of plasticity in the functional networks that underpin cell migration, including how spontaneous as well as perturbation-induced remodeling of these networks produces alternate behavioral patterns. To this end, we have developed a Systems Microscopy research framework that is simultaneously sensitive to both behavioral and organizational heterogeneity, enabling: a) quantitative definition of diverse migratory behaviors as well as critical migration-related macromolecular features (e.g. cell-matrix adhesion complex-, F-actin- and membrane-properties/dynamics); b) delineation of the architecture and plasticity of causal linkages within the cell migration system, and; c) assessment of the impacts and context-dependence of regulatory mechanisms that modulate this system. These capabilities derive from a core platform comprised of single live-cell imaging, automated multi-scale image analysis and statistical evaluation and modelling. We employ this platform in a number of interrelated studies to dissect aspects of plasticity within migration biology. Collectively, our results emphasize the magnitude and extent of plasticity within the functional networks that both comprise and control cell migration, highlighting the likely centrality of this characteristic to any future understanding of the complex cell migration system.