A phase-field approach for studying actin-wave driven cell migration

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Cells migration is an important part of their search for nutrients, of immunological responses, and of developmental processes among others. It is driven by the actin cytoskeleton a network of actin filaments, molecular motors, and other actin-binding proteins. Although many important factors involved in actin-driven cell motility have been identified and characterized in amazing detail, it is still poorly understood how the network is organized in this process. Spontaneous actin waves have been observed in a large number of different cell types and present an attractive concept to understand orchestration of the cytoskeleton during migration. We introduce a mean-field description of spontaneous actin waves. The actin network is confined to an evolving cellular domain by means of a phase field. We numerically solve the dynamic equations and obtain the corresponding phase diagram. In particular, we find erratic motion due to the formation of spiral waves. We compare these findings to experiments and discuss possible physiological consequences.