Spatio-temporal chaos in chemotaxis systems

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In this talk we explore the dynamics of a Keller-Segel model for chemotaxis that incorporates a logistic-type cellular growth term. We demonstrate the capacity of the model to self-organise into multiple cellular aggregations which can lead to sustained spatio-temporal sequences of merging (two aggregations coalesce) and emerging (new aggregations appear). These patterns can be of stationary, periodic or irregular fashion. Numerical explorations into the irregular case indicate a positive Lyapunov exponent (i.e. sensitive dependence to initial conditions) together with a rich bifurcation structure. In particular, we find bifurcation scenarios which resemble a "periodic-doubling" sequence. Based on these results and comparisons with other systems, we argue that the spatio-temporal irregularity observed here describes a form of spatio-temporal chaos.