Hyperbolic and Kinetic Model for Cell Motion

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Self-organisation of cell colonies is of paramount importance in medecine (tissue growth, angiogenesis) and biology (genetic, bacterial invasions). A large variety of chemical processes and biophysical laws can already be involved in communications between cells as simple as bacteria. The simplest of them is chemotaxis when cells interact through a chemoattracting signal; E. Keller and L. Segel proposed the first description using a parabolic system that can exhibit various qualitative behaviors as dispersion or blow-up.

Recently hyperbolic models have been proposed in order to better take into account the smallness of the cell diffusion, the numerous patterns observed in practice and a variety of possible individual behaviors.

In this talk we will focuss on mathematical questions posed by these models. We will first consider the hyperbolic Keller-Segel system and show that the kinetic formulation can handle the question of existence (several other questions as well as other couplings are left open). We will also consider kinetic models of the cell interactions introduced by Alt, Dunbar, Ohtmer and studied by Hadeler, Stevens...etc. We will show that, in opposition to the parabolic model, the kinetic system admits global solutions that converge in finite time to the Keller-Segel model, as a scaling parameter vanishes.