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From microscopic to macroscopic models of cell movement: a numerical approach.

Abstract

In this talk I focus on a quite general class of hybrid mathematical models of collective motions of cells under the influence of chemical stimuli. The models are hybrid in the sense that cells are discrete particles driven by ODE, while the chemoattractant is considered as a continuous signal which solves a diffusive equation. For these models it is possible to prove the mean-field limit in the Wasserstein distance to a system given by the coupling of a Vlasov-type equation with the chemoattractant equation. This approach and results are not based on empirical measures, but rather on marginals of large number of individual densities, and we show the limit with explicit bounds, by proving also existence and uniqueness for the limit system. In the monokinetic case we derive a new pressureless nonlocal Euler-type model with chemotaxis, which will be numerically compared with other macroscopic models of cell movement. Simulation and interpretation of the results will be discussed. These results have been obtained in collaboration for the analytical part with Thierry Paul and, for the numerical part, with Gabriella Bretti, Marta Menci and Tommaso Tenna.