Nonlinear Aggregation-Diffusion Equations in the Diffusion-Dominated and Fair Competitions Regimes

SPEAKER: José A. Carrillo, Imperial College London
TIME: 1:30 pm - 2:30 pm, Wednesday, April 24, 2019
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ABSTRACT

We analyse under which conditions equilibration between two competing effects, repulsion modelled by nonlinear diffusion and attraction modelled by nonlocal interaction, occurs. I will discuss several regimes that appear in aggregation diffusion problems with homogeneous kernels. I will first concentrate in the fair competition case distinguishing among porous medium like cases and fast diffusion like ones. I will discuss the main qualitative properties in terms of stationary states and minimizers of the free energies. In particular, all the porous medium cases are critical while the fast diffusion are not. In the second part, I will discuss the diffusion dominated case in which this balance leads to continuous compactly supported radially decreasing equilibrium configurations for all masses. All stationary states with suitable regularity are shown to be radially symmetric by means of continuous Steiner symmetrisation techniques. Calculus of variations tools allow us to show the existence of global minimizers among these equilibria. Finally, in the particular case of Newtonian interaction in two dimensions they lead to uniqueness of equilibria for any given mass up to translation and to the convergence of solutions of the associated nonlinear aggregation-diffusion equations towards this unique equilibrium profile up to translations as time tends to infinity. This talk is based on works in collaboration with S. Hittmeir, B. Volzone and Y. Yao and with V. Calvez and F. Hoffmann.

BIOGRAPHY

José A. Carrillo currently holds a Chair in Applied and Numerical Analysis at Imperial College London appointed in October 2012. He was the chair of the 2018 Year of Mathematical Biology. He has been elected as member of the European Academy of Sciences, Section Mathematics, in 2018. He is currently the Program Director of the SIAM activity group in Analysis of PDE. His general topics of research include the modelling based on PDE, their mathematical analysis, the numerical schemes, and their simulation in applications. His expertise comprises long-time asymptotics, qualitative properties and numerical schemes for nonlinear diffusion, hydrodynamic, and kinetic equations in the modelling of collective behaviour of many-body systems such as rarefied gases, granular media, charge particle transport in semiconductors, or cell movement by chemotaxis. He was recognised with the SEMA prize (2003) and the GAMM Richard Von-Mises prize (2006) for young researchers. He was a recipient of a Wolfson Research Merit Award by the Royal Society 2012-2017. He was awarded the 2016 SACA award for best Ph.D. Supervision at Imperial College London.