BOLTZMANN-TYPE MODELS OF MULTI-AGENT SYSTEMS ON NETWORKS

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Course Description

This course aims to provide basic notions about how classical mathematical methods of kinetic theory, such as Boltzmann-type equations, Fokker-Planck asymptotics and hydrodynamic limits, may be revisited to investigate emerging socio-physical problems in the realm of interacting multi-agent systems.

In particular, we will discuss how kinetic equations can be formulated and studied on graphs, which constitute a convenient model of compartmental interactions among the agents as opposed to all-to-all interactions in well-mixed populations.

The theory will culminate with the application to the topical problem of the spread of an infectious disease. Here, the graph represents a spatial network of locations through which agents travel and the kinetic approach allows one to build contagion models more accurately focused on the concept of individual social contacts.

Plan of the Lectures

1) Kinetic description of collision-like models and Markov jump processes
2) Boltzmann-type equations for multi-agent systems with label switching
3) Birth and death processes and explicit asymptotic distributions
4) Kinetic modelling of the contagion of infectious diseases
5) Epidemiological kinetic models on networks – Part I
6) Epidemiological kinetic models on networks – Part II

References

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[2] N. Loy and A. Tosin. Boltzmann-type equations for multi-agent systems with label switching. Preprint, 2021. doi: 10.13140/RG.2.2.11726.08001/2

[3] N. Loy and A. Tosin. A viral load-based model for epidemic spread on spatial networks. Preprint, 2021. doi: 10.13140/RG.2.2.14601.16485

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