Boltzmann-type equations for multi-agent systems with label switching

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In this talk, we propose a Boltzmann-type kinetic description of mass-varying interacting multi-agent systems. Our agents are characterised by a microscopic state, which changes due to their mutual interactions, and by a label, which identifies a group to which they belong. Besides interacting within and across the groups, the agents may change label according to a state-dependent Markov-type jump process. We derive general kinetic equations for the joint interaction/label switch processes in each group. For prototypical birth/death dynamics, we characterise the transient and equilibrium kinetic distributions of the groups via a FokkerPlanck asymptotic analysis. As a complex application, we shall introduce a Boltzmann-type kinetic model of the spreading of an infectious disease on a network. The disease transmission is represented in terms of the viral load of the individuals and is mediated by social contacts among them, taking into account their displacements across the nodes of the network. We formally derive the hydrodynamic equations for the density and the mean viral load of the individuals on the network and we analyse the large-time trends of these quantities with special emphasis on the cases of blow-up or eradication of the infection. By means of numerical tests, we also investigate the impact of confinement measures, such as quarantine or localised lockdown, on the diffusion of the disease on the network.

References

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