Mareen Hallier (Brandenburgische Technische Universität Cottbus – Senftenberg):

Constructing Models of Reduced Complexity from Agent-Based Simulation Data – an Information-Theoretic Approach

Abstract:

Agent-based simulation models have been gaining popularity across various fields of application in the social sciences and humanities. The basic idea is to specify the microscopic behavior of the agents via individual rules of behavior and to have the dynamical evolution of the whole system computed iteratively by the computer. There is an increasing recognition that while agent-based modelling is intuitively appealing, reliable analysis of the complex simulation output is challenging and requires rigorous analytical approaches. We propose that the simulation-based construction of models of reduced complexity such as Markov state models is a promising route to address this challenge: Markov state models approximate the original process by a Markov chain on a much smaller state space, can thus expose regularities at a more aggregate level and can in a subsequent step be used to analyze the model dynamics further (e.g., by identifying probable transition paths between different regimes or by identifying optimal policy options). As current approaches mostly rely on reversible dynamics of the original process – an assumption that is generally not fulfilled by agent-based models – we suggest to explore the application and further development of information-based methods for error estimation and model reduction of non-reversible systems in the context of agent-based modelling. These methods quantify the error made by coarse-graining the state space as the resulting information loss on the path space. This quantity can be estimated from the microscopic simulation data and should be minimized in order to construct an optimal model of reduced complexity.