DESCRIPTION FOR THE GENERAL PUBLIC

Fictional science known as *psychohistory*, introduced by Isaac Asimov in his *Foundation* series, as a study which allows to predict the future based on mathematical equations, fascinates not only science fiction lovers but also scientists. The area of social sciences known as *agent-based social simulation* (part of *computational sociology*) is regarded by many as Asimov's psychohistory come true. Usually, agent-based models (ABMs) are defined as computer simulations of social interactions between agents (e.g., individuals, firms, or states), embedded in social structures. Such models are aimed to observe, analyze and understand the emergence of aggregate outcomes, such as public opinion, results of voting, diffusion of innovation, cultural or political revolutions, international terrorism, social inequality or urban ethnic segregation. One of the most important reasons for building ABMs is to explain observed phenomena. However, there is a crucial difference between fictional psychohistory and ABMs. Analogously as it is crucial to realize the difference between explanation and prediction – electrostatics explains lightning, but we cannot predict when or where the next bolt will strike.

Agent-based social simulation is a highly interdisciplinary approach that builds a bridge between the description of social interactions between individuals (social psychology) and the description of structures and processes observed on the level of societies (sociology). Moreover, to analyze such models, methods of statistical physics, in particular the theory of phase transitions and critical phenomena, has been proven to be highly useful.

Although the origins of ABMs in sociology can be traced back to the 1960s, it was only in the 1990s that ABM applications reached a critical mass. Almost simultaneously, yet somehow independently, the new field of *sociophysics* emerged as part of statistical physics. However, similarly as in the case of computational sociology, the widespread acceptance of this interdisciplinary field came only 20 years later. Physicists can certainly help social scientists in developing computational social science by offering their experience gained over the last century through studies on statistical mechanics. However, ABMs should be always built on the basis of social theories and/or results of social experiments. Without such an interdisciplinary and rigorous approach AMBs are rather toys than tools. Therefore, within this project we plan to utilize the rich knowledge database of statistical physics to construct, analyze and generalize models of opinion dynamics. However, what is extremely important, **all models will be based on social theories, investigated in collaboration with social psychologists and constructed on the basis of empirical data and social experiments**.

We will focus in this project on models of opinion dynamics, since these are the starting point to develop ABMs of various social processes. One of the pivotal elements to be considered when building an ABM of opinion dynamics is the precise definition of an agent and the rules that change the opinion of agents. These rules should be obviously based on psychological theories of social influence, but it is not clear which one of them to choose. Therefore the question we ask is, **if introducing different models of social influence on the microscopic (i.e. ABM) level will influence the results on the macroscopic (aggregate) level?** And consequently, would it be possible to deduce from the level of the society what are the interactions between individuals? The inspiration for this project comes mainly from two sources – social psychology that recognizes different models of social response and the observation related to agent-based modeling that there has been little effort in the literature to provide an analysis of how the results differ depending on the model designs. After about 20 years of applying ABMs in the social sciences, the situation has not changed much. Still we can observe a rather fast increase in the number of different models, but very few studies with a systematic sensitivity analysis of these models and comparative analyses between them. Therefore, the main challenge posed in this project is to **rigorously analyze different ABMs that are aimed at describing the same social phenomena, in this case opinion dynamics. In particular we plan to conduct a sensitivity analysis of these models, as well as a comparative analysis between them**.