Modeling Practice Diffusion with an Agent-Based Social Simulation Framework

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Agent-based social simulation has provided the scientists a useful tool for analyzing social phenomena without costly real-life experiments. In this work, we present a multiagent simulation framework for simulating the diffusion of practices among a group of agents. This relates to the diffusion of innovations, except that we model the diffusion of existing practices instead of new innovations. From the point of view of social sciences, this work draws inspiration from the practice theory (see e.g. [1, 2]).

When the simulation is started, the agents begin to interact with each other recommending their practices to the other agents. The system simulates how the agent society will evolve – what new practices the agents adopt from each other and what practices are dismissed. Our goal has been to build a framework that can handle diverse data and diverse interaction models. As input data, the simulation uses a list of practices for each agent and a list of properties for each practice. A practice can be, for example, a hobby or a listening habit.

The high-dimensional space of practices is analyzed and visualized using the self-organizing map algorithm. The self-organizing map (SOM) is an unsupervised artificial neural-network algorithm that can be used for dimensionality reduction and data visualization [3]. It projects n-dimensional data vectors in a nonlinear fashion to a lower, usually two dimensional map.

To help us follow the progress of the simulation, we have two self-organizing maps in our framework: the agent map and the practice map. The agent map is trained with agents' initial practices and the practice map with practices' properties. When agents interact with each other, their practice vectors change and they are mapped to new cells on the agent map, so that if two agents are nearby on the map, they have similar practices. The practice map, on the other hand, visualizes the practice distribution of a single agent. Figure 1 shows an example of the maps.

To interact with each other, all agents do the following procedures in each simulation step: 1. Choose the influencing partner (*influencer*); 2. Choose one practice from the influencer; 3. Increase agent's time spent for that practice; 4. Decrease agent's time spent for other practice(s) so that the total time remains constant. The procedures are implemented stochastically so that, e.g., the more similar two agents are, the more likely they will interact with each other. The similarity is measured as the Euclidean distance on the agent map.

To demonstrate the framework, we have run example simulations with music listening data gathered from Last.fm service. Last.fm is a free Internet radio

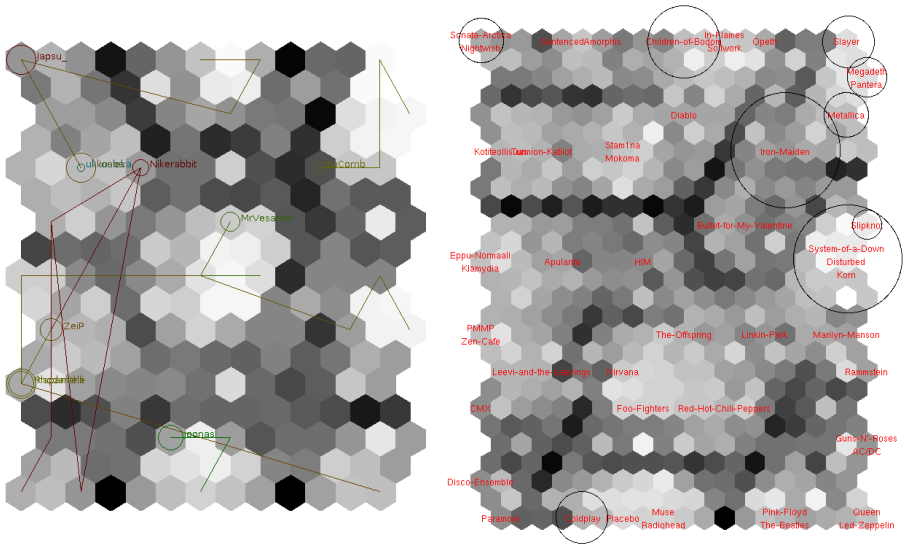

Fig. 1. Agent map (left): The agents are marked with circles. Trajectories show how agent's practices have changed during the simulation. Practice map (right): Circles show which practices the chosen agent has. The larger the circle the more time the agent uses on the corresponding practice.

service that tracks music listening habits of the registered users. From Last.fm, we have taken a group of people and the information about what artists they listen to and how much, and what tags have those artists been given to and how many times.

The example simulations show us that the framework is functional and it supports different data and interaction models. The current set of models is rather limited. Nevertheless, with models based on sociological research and empirical evidence, the framework could prove to be a useful tool for analyzing the diffusion of practices. It also provides a useful visualization mechanism utilizing self-organizing maps.

References

1. Pantzar, M.: The choreography of everyday life: A missing brick in the general evolution theory. World Futures, The Journal of General Evolution **27**(3) (1989) 207–226
2. Shove, E., Pantzar, M.: Consumers, producers and practices: understanding the invention and reinvention of nordic walking. Journal of Consumer Culture **1** (2005) 43–64
3. Kohonen, T.: Self-Organizing Maps. Springer (2001)