

The goal of the project

The world we are living in currently, isn't the same world as the one thirty years ago when about the way how we communicate. Newspapers, television, Internet, mobile phones definitely changed the speed and directions of how information travels through the society. Moreover, as the process of globalisation follows, often we communicate with people from very distant locations with the same frequency as with relatives and friends living in the same city. These changes definitely influenced our social neighbourhood, and, to be more precise, on the social networks we build and maintain each day. A social network, the set of people and relationships between them is nothing else than a formal representation of our everyday contacts in many aspects of our life: among family members and friends, at work, on the Internet. Each of us builds this network in an unconscious way, however, due to technological progress, many of these networks can be observed and analysed. For instance, more and more people use social networking websites such as Facebook and Twitter, where it is we may add friends or to follow some profiles. Thanks to the opportunity to extract the data, it is possible to build a social network that will show what are the paths of information traversal among its members, who is important in that network or how the groups look like.

One of important areas that is analysed in social networks, are the dynamic processes that take place there, such as diffusion of information and innovation or spread of influence. Each of them is related with different sociological process, but all change the network state in some sense – we receive information, we buy some product or change our opinion on something. In other words, in the social network a process occurs that can be observed in means of its speed and direction. For many years we analysed how the society introduces and adapts innovations or which social network members are the best candidates to advertise products in order to maximize the total effect (e.g. through whispering campaign).

At the same time, for simplicity it was assumed that the social networks analysed are not changing over time and researchers focused on analysing so called static or time-aggregated networks – the time factor was omitted and it has a tremendous impact on the information diffusion. In recent years (abt. 2010-2013) empirical research shown that by ignoring the time aspect significantly influences the results of analysis and forecasting the dynamical processes that take place in social networks, i.e. diffusion of information and innovations or spread of influence. Because the change in the network is somewhat natural process, since we meet new people, break some relationships or change the means and intensity of contacts, this is why we should focus on analysing dynamic networks instead of static ones.

The goal of this project is to analyse the dependence between the network dynamics and the processes occurring in these networks, since our knowledge in this area is still insufficient. As it was already observed, many of our activities are bursty, i.e. these are very intense in short periods, but then there are huge gaps between next bursts. This project is intended to analyse how this phenomenon slows down or accelerates diffusion of innovations or social influence in social networks and what are the methods to maximize the outcomes of these processes.

Planned research tasks

In order to answer on the fundamental research questions, the project is focused on two dynamic processes that occur in social networks, namely the social influence and diffusion of innovations. Both have been extensively analysed in static networks, but they differ in means of sociological background and models used to represent them. In order to shift the problem from static to dynamic setting, the basic task is to model the dynamic underlying social network properly. That topology, i.e. temporal social network, will be then used to observe and analyse the above presented processes. Saying that, the first research task is the analysis of currently available models for temporal networks in order to choose the proper one or to develop a new one. In this task the real-world data based temporal networks will be created as well as artificial networks – both will be used to analyse the diffusion of innovations and spread of influence in the following tasks.

The next two tasks the above processes will be analysed, or, more specifically, the influence of network dynamics on their outcomes. The research will focus on finding the relationship between the processes and network dynamics showing when the network dynamics speeds up and when it slows down these processes. For instance, we will learn whether our often contacts with friends accelerate or slow down the diffusion of an opinion in the social network or how possible is to promote a product in the network where its members have rare contacts between each other. Moreover, new methods for choosing seeds in temporal networks will be created in order for those to maximize the social influence.

Motivation

Temporal, i.e. dynamic social networks are our everyday life – it is unlikely to say that our relationships with others are constant in time. At the same time, as it was shown, the change of the network never was extensively analysed by researchers, especially when thinking of dynamic processes that occur in that network. Nowadays, when we already have appropriate tools and techniques, it is possible to shift the concepts of diffusion of innovations or spread of influence in the area of temporal networks. The obtained knowledge will allow to answer the questions how the network dynamics influences these processes, what in turn shall improve the effectiveness of information spread. It is worth underlining that similarly to the influence of network dynamics on diffusion processes, the same dynamics influences spread of diseases. The higher the understanding how they influence each other, the better the models will be what can result in better modelling epidemics.

The need to propose the project comes from the fact that as of now, it was impossible to find a complex attempt to analyse the binding between the network dynamics and the processes occurring in it. Moreover, the results published so far show often either contradictory or hard to generalize conclusions. This project aims to answer the research questions in a far more complex way, trying to become a foundation for further research in this area.