

Models, methods and algorithms of computational network science

The networks surround us everywhere. We keep alive our family ties, friendships or professional relationships (social networks). We travel over transportation networks, powered by power grids and controlled by computer networks. Our brain is a map of 100 billion neural connections (connectome). Our natural language is a web of words and meanings. Trade activities and ownership relations determine our economic behaviour, whereas food web keeps us leaving. Complex networks are a crucial component of all complex systems.

To systemize such world, and interdisciplinary network science was established in early 2000'. It aims to understand the impact of network structures on micro and macro system behaviour.

We propose to create a new science – computational network science that links computer science with its deep understanding of real data and network science providing a general snapshot of networks. As a result, we would like to obtain solutions that enable to learn about real world phenomena in the even more complex environments: multimodal networks, multilayer networks evolving over time – temporal complex networks.

New models, methods and algorithms facilitate the high-performance processing of large datasets and public published tools enable understanding and sometimes even control of dynamic processes spreading over the network. These processes could be information diffusion on Twitter, popularity of movies on YouTube or adaptability of information flows between neurones in our brain. We would like to know if the damage in a power plant in Serbia will course a blackout in Finland. What is stability and resilience of our financial system? Is the structure of Polish science like in other countries? Can we improve the distribution of renting bike stations in the city? Why the structure of web pages is similar to human social relationships and if it is always so? Can we increase coverage of our word of mouth online campaign in its runtime? These are examples of questions which the project will support finding the answer. It also extends possibilities for reasoning from any large-scale networked data.

Establishing a new domain has to be done at the world level, so it would not be possible without the engagement of the best, recognizable researchers, especially from the USA. The project team is aware of that, but effects are driven by our aspirations. An example of project team effectiveness is *A Global Discussion Panel on Computational Network Science* successfully organized in Wrocław with teleport to the USA in January 2016. Great American professors participated in it.