Understanding complex relationships

Scientists from Freiburg show how global properties of networks become apparent in local characteristics

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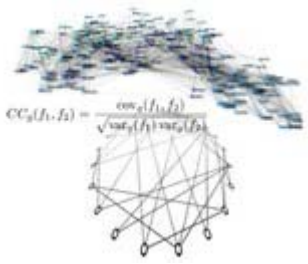

Statistical analyses allow to compare natural networks like the nervous system of a worm (top) with theoretical model networks (bottom). Image: Bernstein Center Freiburg; worm network after Varshney et al., PLoS Comp Biol. 2011.

From infections spreading around the globe to the onset of an epileptic seizure in the brain: Many phenomena can be seen as the effects of network activity. Often it is vitally important to understand the properties of these networks. However, they are often too complex to be described completely. Scientists from the Bernstein Center at the University of Freiburg were now able to show how global

features of complex networks can be discovered in local statistical properties – which are much more accessible for scientific investigation. The researchers were able to benefit from the high-performance computing facilities of the Bernstein Center, which are normally used to simulate the activity of nerve cells in the brain.

In an article appearing in the scientific journal PLoS ONE, **Stefano Cardanobile** and colleagues describe how they analysed 200,000 networks which they generated in a computer – using models that are employed by scientists to understand the properties of naturally occurring networks. The researchers compared the results obtained from these models with well-understood networks from the real world: the metabolism of a bacterium, the relationship of synonyms in a thesaurus, and the nervous system of a worm. Thus, they were able to assess which model networks can predict the behaviour of its real-life counterpart the best. These insights can help colleagues from other fields to choose the right model in their specific research.

Most importantly, the scientists from Freiburg could demonstrate that it is possible to draw conclusions about global properties of complex networks from local statistical data. This means that one can discover important properties of networks even if they are not completely analysed – very often an impossible task in large systems such as human social contacts or connections in the brain. Therefore, the authors see their study to represent an important step towards a better understanding of complex networks.

Original article:

Cardanobile S, Pernice V, Deger M and Rotter S (2012) Inferring general relations between network characteristics from specific network ensembles. PLoS ONE, http://dx.plos.org/10.1371/journal.pone.0037911

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