CoCo Seminar Series
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Connecting Dynamics on and of Networks to Data: Motif-Based and Mean-Field Approaches

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Hybrid (EB-T1 & Zoom; meeting link available on
http://coco.binghamton.edu/)

The study of motifs in networks can help researchers uncover links between the structure and function of networks in biology, sociology, economics, and many other areas. Empirical studies of networks have identified feedback loops, feedforward loops, and several other small structures as "motifs" that occur frequently in real-world networks and may contribute by various mechanisms to important functions in these systems. However, these mechanisms are unknown for many of these motifs. To create a foundation for uncovering these mechanisms via theoretical models, I study the incremental contributions of motifs in networks to correlation patterns in node activity in linear stochastic systems. The results paint an intuitive picture of the emergence of correlation patterns in complex systems, and they provide insights into the issues that arise when researchers use correlation patterns in high-dimensional systems to infer causal relationships. Building on these insights, I propose to refine structural inference from lagged correlation matrices via easy-to-compute correction terms. This approach achieves accuracies higher than commonly used methods in structural inference from time-series data (i.e., Granger causality, transfer entropy, and convergent crossmapping), but with much shorter computation time than possible with any of these methods. It is thus a promising alternative to current paradigms for the inference of linear models, and it is an example of how ideas from network theory and dynamical systems can improve and extend the tools for data science. I will close with an outlook on my current work, in which I work to extend this motif-based framework to the dynamics of coevolving networks.

Dr. Alice Schwarze is an applied mathematician with interests in dynamical systems and complex networks. She received her DPhil (PhD) in mathematics from the University of Oxford in 2019. Subsequently, she has conducted postdoctoral research at the Department of Biology at the University of Washington (2019-2021) and the Department of Mathematics at Dartmouth College (2021-present). Dr. Schwarze is committed to improving diversity, equity, and inclusion in academia and higher education. Since 2020, she has convened the Women in Network Science seminar to improve the visibility of women researchers in network science and further recognition for their work. In 2021, she was elected president of the Women in Network Science Society. With the aim to make network science more diverse and inclusive, she joined the board of the Network Science Society in 2023.

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