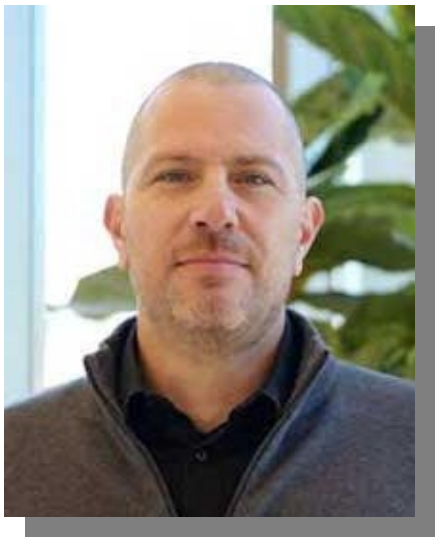
CoCo Seminar Series Summer 2024

Modeling Resource Consumption and Transit Efficiency in Transport Systems with Percolation and Multiplex Networks



Dr. Filippo Radicchi
Professor, Center for Complex Networks and Systems Research / Luddy School of Informatics, Computing, and Engineering, Indiana University

Monday July 1, 2024 12:00-1:00pm EDT
Hybrid (EB-T1 & Zoom; meeting link available on http://coco.binghamton.edu/)

In the first part of the talk, I introduce a percolation model aimed at mimicking the consumption, and eventual exhaustion, of resources in transport networks. In the model, edges forming minimum-cost paths connecting demanded origin-destination nodes are removed if the cost associated with these paths is below a certain budget. As pairs of nodes are demanded and edges are removed, the macroscopic connected component of the graph disappears, i.e., the graph undergoes a percolation transition. I characterize such a transition by means of finite-size scaling analysis, showing that different critical properties emerge depending on whether the budget parameter of the percolation model is bounded or not. In the second part of the talk, I consider a multiplex network with a fast layer embedded in a slow one. To move between any pair of nodes, one can then use either the fast or slow layer, or both, with a switching cost when going from one layer to the other. I take advantage of analytical and numerical arguments to show that the optimal structure minimizing the transit time in the network is characterized by symmetry breaking, indicating that it is sometimes better to avoid serving a whole area in order to save on switching costs, at the expense of using more the slow layer. I finally discuss the relevance of the model to estimate the efficiency of the subway system in the cities of Atlanta, Boston, and Toronto.

Filippo Radicchi is a Professor in the Luddy School of Informatics, Computing, and Engineering at Indiana University, where he serves as the director of the Center for Complex Networks and Systems Research. Also, he is an Associate Editor for Physical Review E. He was a "Ramón y Cajal" senior researcher at university Rovira i Virgili, a postdoctoral researcher at Northwestern University, and a research specialist at ISI Foundation. He has a PhD in Physics from Jacobs University Bremen, and a MS in Physics from University of Rome Tor Vergata. He was the recipient of the junior award from the Complex Systems Society in 2014 and of the CAREER award from the National Science Foundation in 2016. He authored more than 100 publications, and his research in statistical physics focuses on modeling structural and dynamical processes in complex networks.