CoCo Seminar Series Spring 2017

Urban Morphology and Structural Invariants in Street Networks

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(note the irregular time)
Engineering Building H-9 (Knoll-MacDonald Commons / Watson Commons)

Streets networks are the primary facilitators of movement in urban systems, allowing residents to navigate the different functional components of a city. Since navigability is a key ingredient of socioeconomic activity, roads represent one of its most important infrastructural components and a large body of work has elucidated its structural properties. Yet more than the physical layout, it is the sampling of street networks that serves as a true fingerprint of the complex interactions between people, and the flow of goods and services in urban systems, a feature of which there is limited understanding. To fill this gap, we conducted a systematic mesoscale study of street morphology (shape of sampled routes) through the introduction of a novel metric that we term inness. The inness encapsulates the direction, orientation and length of routes, thus revealing the morphology of connectivity in street networks, including the distribution of implicit socioeconomic forces that may inform routing choices. In particular, this metric enables us to put functions of individual streets in the context of the dynamics of the whole city (Broadway or Fifth avenue in NYC, for instance), linking local structures to large-scale urban organization. The dynamics of a city of course is intricately related to the flow of people and goods and services, a structural measure of which is the betweenness centrality. We show that the global distribution of betweenness is an invariant quantity once one accounts for the proper scale and provide a qualitative analytical description, based on Minimal Spanning Trees embedded in 2D space, to explain this remarkable invariance.

Dr. Gourab Ghoshal is Assistant Professor of Physics and Astronomy with joint appointments at the departments of Computer Science and Mathematics at the University of Rochester. Dr. Ghoshal received his bachelor's and master's degree at the University of London, UK (BS and MSc in Theoretical Physics, 2004). He did his doctoral-thesis work at the University of Michigan, Ann Arbor (PhD in Physics, 2009). Following his PhD, he was a postdoctoral scientist jointly at Northeastern University and Harvard Medical School as well as a visiting scientist at the MIT Media Lab. His research interests are in the theory and applications of complex networks as well as non-equilibrium statistical physics, game theory, econophysics, dynamical systems and the origins of life.

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