Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Extracting Hidden Hierarchies in 3D Distribution Networks

CARL MODES, MARCELO MAGNASCO, Rockefeller University, ELENI KATIFORI, Max Planck Institute for Dynamics and Self-Organization — Natural and man-made transport webs are frequently dominated by dense sets of nested cycles. The architecture of these networks – the topology and edge weights – determines how efficiently the networks perform their function. Yet, the set of tools that can characterize such a weighted cycle-rich architecture in a physically relevant, mathematically compact way is sparse. In order to fill this void, we have developed a new algorithm that rests on an abstraction of the physical 'tiling' in the case of a two dimensional network to an effective tiling of an abstract surface in space that the network may be thought to sit in. Generically these abstract surfaces are richer than the plane and upon sequential removal of the weakest links by edge weight, neighboring tiles merge and a tree characterizing this merging process results. The properties of this characteristic tree can provide the physical and topological data required to describe the architecture of the network and to build physical models. This new algorithm can be used for automated phenotypic characterization of any weighted network whose structure is dominated by cycles, such as mammalian vasculature in the organs, the root networks of clonal colonies like quaking aspen, or the force networks in jammed granular matter.

Carl Modes
Rockefeller University

Date submitted: 14 Nov 2014 Electronic form version 1.4