UNIVERSITÄT LEIPZIG

Fakultät für Physik und Geowissenschaften

Prof. Dr. J. Deiglmayr
Prof. Dr. J. Vollmer

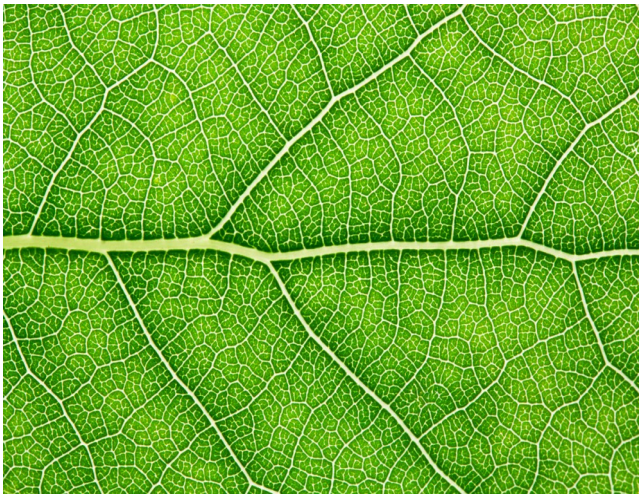
Physics Colloquium

Tuesday, 14 December 2021 at 17:15

Prof. Dr. Eleni Katifori

University of Pennsylvania

Local rules for global optimization of distribution networks



From the microvasculature in our own bodies to the vast river networks that span entire continents, flow networks are ubiquitous at all length scales in nature. These distribution networks are built and constantly remodeled based on rules of evolution that dictate the fate (growth or shrinkage) or the network links. In biology, flow networks play important functional roles such as delivery of nutrients, removal of waste, temperature regulation, and more. As a result, they are under strong evolutionary pressure to optimize different cost functions, including the energetic cost to overcome viscous dissipation, the material cost to build and maintain the network, or the need to uniformly distribute nutrients across the whole tissue. In this talk we will discuss how networks that optimize these cost functions can be built by adaptive rules for the links. These adaptive rules remodel the network using only local information about the links, without an explicit knowledge about the global state of the system. Using oxygen distribution in the microvasculature as a test case, we will establish structure-function relationships for the network topology.

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