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Emerging hierarchies in dynamically adapting webs ELENI KATIFORI, University of Pennsylvania, JOHANNES GRAEWER, Max-Planck Institute for Dynamics and Self-Organization, MARCELO MAGNASCO, CARL MODES, Rockefeller University — Transport networks play a key role across four realms of eukaryotic life: slime molds, fungi, plants, and animals. In addition to the developmental algorithms that build them, many also employ adaptive strategies to respond to stimuli, damage, and other environmental changes. We model these adapting network architectures using a generic dynamical system on weighted graphs and find in simulation that these networks ultimately develop a hierarchical organization of the final weighted architecture accompanied by the formation of a system-spanning backbone. We quantify the hierarchical organization of the networks by developing an algorithm that decomposes the architecture to multiple scales and analyzes how the organization in each scale relates to that of the scale above and below it. The methodologies developed in this work are applicable to a wide range of systems including the slime mold physarum polycephalum, human microvasculature, and force chains in granular media.

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