Title:	Spectral Properties of Ensnarled Networks
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Abstract:	Organs like the liver and pancreas consist of intricate transport systems vital for their en- docrine and exocrine functions. These systems consist of two spatially separate vessel net- works interlinked within the same 3D space. We define such interlinking as ensnarlment. We utilize a previous study that uses the cyclic nature of each network and the Gauss link- ing integral to construct a linkage matrix based on Hopf-linked cycles, which is then used to construct the so called ‘edge priority’ matrices in the edge space. Elements of these priority matrices denote which edges of the graphs are most critical in the linkage. Our analysis fo- cuses on exploring the spectral properties of this priority matrix for different network types. We study the variations between ensnarled planar graphs, highly symmetrical 3D lattices, and random Voronoi graphs. Spectral properties of such established network types provide a foundational reference for future investigations on unknown systems. We use this to ana- lyze the ensnarlment in mouse liver networks as they develop after birth. We also set up a novel bipartite representation for the ensnarlment. This work establishes a novel framework for analyzing and characterizing the structural properties of intertwined networks, and pro- vides a foundation for future investigations into the intricate nature of organ functionality with potential implications for organ development, disease, and regeneration.
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