Modulus, Duality, and Families of Objects on Graphs

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Given a discrete graph and a family of objects (walks, spanning trees, edge covers, etc.) on the graph, p-modulus provides a mathematical way to quantify the "richness" or "robustness" of that family. Acting as a tunable metric, p-modulus generalizes classical graph metrics—such as shortest path, effective resistance, and minimum cut—to provide a multifaceted view of the graph's topology and geometry. Through the lens of modulus, we can explore a variety of structural properties of the graph. This talk will introduce p-modulus, describe its basic properties, connect it to well-known graph-theoretic quantities, and explore the powerful theory of Fulkerson blocking duality, which connects each family of objects to a natural dual family that provides deep insights into the graph's structural properties.