Title:
A New Notion of Effective Resistance for Directed Graphs

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Abstract:
The graphical notion of effective resistance has found wide-ranging applications in many areas of pure mathematics, applied mathematics and control theory. By the nature of its construction, effective resistance can only be computed in undirected graphs and yet in several areas of its application, directed graphs arise as naturally (or more naturally) than undirected ones. In this talk, we propose a generalization of effective resistance to directed graphs that preserves its control-theoretic properties in relation to consensus-type dynamics. We proceed to analyze the dependence of our algebraic definition on the structural properties of the graph and the relationship between our construction and a graphical distance. The results make possible the calculation of effective resistance between any two nodes in any directed graph and provide a solid foundation for the application of effective resistance to problems involving directed graphs. Finally, we compute effective resistances in some prototypical directed graphs. This computation highlights cases where our notion of effective resistance for directed graphs behaves analogously to our experience from undirected graphs, as well as cases where it behaves in unexpected ways.