SPECTRUM OF A NORMALIZED COMPLEX LAPLACIAN ON FINITE ELECTRICAL NETWORKS

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It is know, that weighted graphs can be considered as electrical networks with resistors (in this case weights are called *conductances*). We consider electrical networks with inductors, capacitors and resistors. In this case a generalization of conductance is called *admittance* and it is a positive real rational function (on complex parameter s). More precisely, for an edge xy it can be written as

$$\rho_{xy}^{(s)} = \frac{s}{L_{xy}s^2 + R_{xy}s + D_{xy}},$$

where $L_{xy}^2 + R_{xy}^2 + D_{xy}^2 \geq 0,\ L_{xy}, R_{xy}, D_{xy} > 0$ and we consider all $s \in \mathbb{C}$ with positive real part, although initially $s = i\omega$ (ω is a frequency of alternating current, i is an imaginary unit). The Dirichlet problem and Laplace operator on such graphs arise naturally from the problem of finding voltages in electrical network.

We investigate the spectrum of normalized Laplace operator of finite graphs, whose weights are positive real functions on complex parameter, lying in the right half-plane, and show the sharpness of our estimates. It is shown that eigenvalues lie in a larger region compared to the case of the real Laplacian. Moreover, we present an estimate from below for the first non-vanishing eigenvalue in modulus .

References

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