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Spectral analysis for a family of treelike networks

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Abstract

For a network, knowledge of its Laplacian eigenvalues is central to understand its structure and dynamics. In this paper, we study the Laplacian spectra and their applications for a family of treelike networks. Firstly, in order to obtain the Laplacian spectra, we calculate the constant term and monomial coefficient of characteristic polynomial of the Laplacian matrix for a family of treelike networks. By using the Vieta theorem, we then obtain the sum of reciprocals of all nonzero eigenvalues of Laplacian matrix. Finally, we determine some interesting quantities that are related to the sum of reciprocals of all nonzero eigenvalues of Laplacian matrix, such as Kirchhoff index, global mean-first passage time (GMFPT).

Keywords Laplacian spectra, treelike network, Kirchhoff index, global mean-first passage time.

1 Introduction

Over the years, the study of networks associated with complex systems has received a great deal of attention of researchers from different scientific fields [1, 2, 3, 4, 5, 6, 7, 8, 9]. The key to the study of complex systems is understanding the topological structure. The Laplacian eigenvalues of a network provide important insight into structural features and dynamical properties on the network [10, 11, 12, 13, 14, 15, 16]. For example, the second smallest eigenvalue of the Laplacian matrix of a network is related to its diameter; the product of all nonzero Laplacian eigenvalues

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