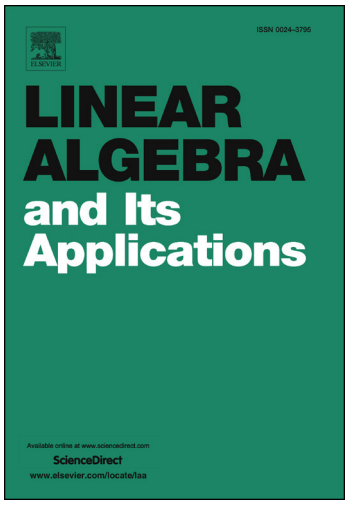

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Zhijun Wang, Dein Wong

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The characteristic polynomial of lexicographic product of graphs

Zhijun Wang, Dein Wong[1]

School of Mathematics, China University of Mining and Technology, Xuzhou, 221116, P. R. China

Abstract

Let G and H be two simple graphs. In this paper, the characteristic polynomial of $G[H]$, the lexicographic product of G and H, is determined. As an application, the characteristic polynomial and the spectrum of $G[H]$ are obtained explicitly when H has exactly one or two main eigenvalues.

Keywords: Lexicographic product, Main eigenvalue, Characteristic polynomial, Spectrum
2000 MSC: 05C50

1. Introduction

The characteristic polynomial of a graph is defined as the characteristic polynomial of its adjacency matrix. The spectrum, eigenvalues, eigenvectors and eigenspaces of a graph are defined similarly. Let G be a graph with $\{1, 2, \cdots, m\}$ as its vertex set, let $H_1, H_2, \cdots, H_m$ be m disjoint graphs. The generalized lexicographic product, denoted by $G[H_1, H_2, \cdots, H_m]$, is formed by taking $H_1, H_2, \cdots, H_m$, and then joining every vertex of H_i to every vertex of H_j whenever i is adjacent to j in G. When $H_1 = H_2 = \cdots = H_m = H$, the generalized lexicographic product $G[H_1, H_2, \cdots, H_m]$ is reduced to the lexicographic product $G[H]$. The lexicographic product of graphs is a binary operation which can generate new graphs from old ones. Different from other binary operations such as Cartesian product and strong product of graphs [6], lexicographic product of graphs does not satisfy commutative law and its characteristic polynomial can not be determined by that of the two constituent graphs in general.

Email addresses: wangzhijuncumt@163.com (Zhijun Wang), wongdein@163.com (Dein Wong)

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