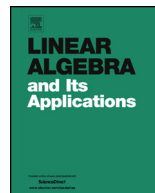




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Linear Algebra and its Applications

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Cospectrality of graphs



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ARTICLE INFO

Article history:

Received 17 October 2013

Accepted 15 February 2014

Available online 2 April 2014

Submitted by R. Brualdi

MSC:

05C50

05C31

Keywords:

Spectra of graphs

Measures on spectra of graphs

Adjacency matrix of a graph

ABSTRACT

Richard Brualdi proposed in Stevanović (2007) [6] the following problem:

(Problem AWGS.4) Let G_n and G'_n be two nonisomorphic graphs on n vertices with spectra

$$\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n \quad \text{and} \quad \lambda'_1 \geq \lambda'_2 \geq \dots \geq \lambda'_n,$$

respectively. Define the distance between the spectra of G_n and G'_n as

$$\lambda(G_n, G'_n) = \sum_{i=1}^n (\lambda_i - \lambda'_i)^2 \quad \left(\text{or use } \sum_{i=1}^n |\lambda_i - \lambda'_i| \right).$$

Define the cospectrality of G_n by

$$\text{cs}(G_n) = \min\{\lambda(G_n, G'_n) : G'_n \text{ not isomorphic to } G_n\}.$$

Let

$$\text{cs}_n = \max\{\text{cs}(G_n) : G_n \text{ a graph on } n \text{ vertices}\}.$$

Problem A. Investigate $\text{cs}(G_n)$ for special classes of graphs.

Problem B. Find a good upper bound on cs_n .

In this paper we study **Problem A** and determine the cospectrality of certain graphs by the Euclidian distance.

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Let K_n denote the complete graph on n vertices, nK_1 denote the null graph on n vertices and $K_2 + (n-2)K_1$ denote the disjoint union of the K_2 with $n-2$ isolated vertices, where $n \geq 2$. In this paper we find $\text{cs}(K_n)$, $\text{cs}(nK_1)$, $\text{cs}(K_2 + (n-2)K_1)$ ($n \geq 2$) and $\text{cs}(K_{n,n})$.

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1. Introduction

Throughout the paper all graphs are simple, that is finite and undirected without loops and multiple edges. By the spectrum of a graph G , we mean the multiset of eigenvalues of adjacency matrix of G .

Richard Brualdi proposed in [6] the following problem:

(Problem AWGS.4) Let G_n and G'_n be two nonisomorphic graphs on n vertices with spectra

$$\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_n \quad \text{and} \quad \lambda'_1 \geq \lambda'_2 \geq \cdots \geq \lambda'_n,$$

respectively. Define the distance between the spectra of G_n and G'_n as

$$\lambda(G_n, G'_n) = \sum_{i=1}^n (\lambda_i - \lambda'_i)^2 \quad \left(\text{or use } \sum_{i=1}^n |\lambda_i - \lambda'_i| \right).$$

Define the cospectrality of G_n by

$$\text{cs}(G_n) = \min \{ \lambda(G_n, G'_n) : G'_n \text{ not isomorphic to } G_n \}.$$

Thus $\text{cs}(G_n) = 0$ if and only if G_n has a cospectral mate. Let

$$\text{cs}_n = \max \{ \text{cs}(G_n) : G_n \text{ a graph on } n \text{ vertices} \}.$$

This function measures how far apart the spectrum of a graph with n vertices can be from the spectrum of any other graph with n vertices.

Problem A. Investigate $\text{cs}(G_n)$ for special classes of graphs.

Problem B. Find a good upper bound on cs_n .

In this paper we study [Problem A](#) and determine the cospectrality of certain graphs by the Euclidian distance, that is

$$\lambda(G_n, G'_n) = \sum_{i=1}^n (\lambda_i - \lambda'_i)^2.$$

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