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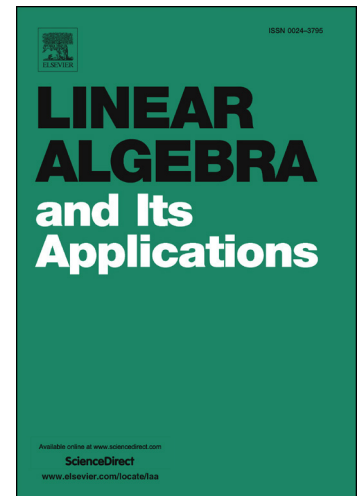
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On the sum of Laplacian eigenvalues of a signed graph

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Abstract

For a signed graph Γ , let $e(\Gamma)$ denote the number of edges and $S_k(\Gamma)$ denote the sum of the k largest eigenvalues of the Laplacian matrix of Γ . We conjecture that for any signed graph Γ with n vertices, $S_k(\Gamma) \leq e(\Gamma) + \binom{k+1}{2} + 1$ holds for $k = 1, \dots, n$. We prove the conjecture for any signed graph when $k = 2$, and prove that this conjecture is true for unicyclic and bicyclic signed graphs.

MSC: 05C50

Keywords: signed graphs, sum of eigenvalues, Laplacian matrix

1 Introduction

In this paper, all graphs are simple (loopless and without multiple edges). The vertex set and edge set of the graph G will be denoted by $V(G)$ and $E(G)$, respectively. A *signed graph* (or *sigraph* for short) $\Gamma = (G, \sigma)$ consists of an unsigned graph $G = (V, E)$ and a sign function $\sigma : E(G) \rightarrow \{+, -\}$, and G is its underlying graph, while σ is its sign function (or signature). Furthermore, it is also to interpret the signs as the integers $\{+1, -1\}$. Hence, signed graphs sometimes are treated as weighted graphs, whose (edge) weights is 1 or -1 . An edge e is *positive* (*negative*) if $\sigma(e) = +$ (resp. $\sigma(e) = -$). If all edges in Γ are *positive* (*negative*), then Γ is denoted by $(G, +)$ (resp. $(G, -)$).

Actually, each concept defined for the underlying graph can be transferred with signed graphs. For example, the degree of a vertex v in G is also its degree in Γ . Furthermore, if some subgraph of the underlying graph is observed, then the sign function for the subgraph is the restriction of the previous one. Thus, if $v \in V(G)$, then $\Gamma - v$ denotes the signed subgraph whose underlying graph is $G - v$ and its signature is the restriction from $E(G)$ to $E(G - v)$. If $U \subseteq V(G)$ then $\Gamma[U]$ or $G(U)$ denotes the (signed) induced subgraph arising from U , while $\Gamma - U = \Gamma[V(G) \setminus U]$. Sometimes we also write $\Gamma - \Gamma[U]$

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