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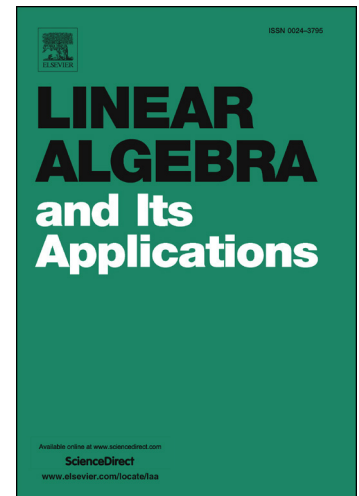
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# Spectral properties of general hypergraphs

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## Abstract

In this paper, we investigate spectral properties of the adjacency tensor, Laplacian tensor and signless Laplacian tensor of general hypergraphs (including uniform and non-uniform hypergraphs). We give some properties for the spectral radius of hypergraphs, and obtain spectral upper bounds for the chromatic number of hypergraphs. The odd-bipartiteness of hypergraphs can be recognized from the spectrum. We give a relation between the analytic connectivity and edge connectivity of a hypergraph, and show that a hypergraph with even rank is connected if and only if its analytic connectivity is larger than 0. We also give some relations between the analytic bipartiteness and odd-bipartiteness of hypergraphs.

*Keywords:* Hypergraph, Adjacency tensor, Laplacian tensor, Spectrum, Analytic connectivity, Analytic bipartiteness

*AMS classification:* 05C65, 05C50, 15A69, 15A18

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## 1. Introduction

Let  $V(H)$  and  $E(H)$  denote the vertex set and the edge set of a hypergraph  $H$ , respectively. A hypergraph  $G$  satisfying  $V(G) \subseteq V(H)$ ,  $E(G) \subseteq E(H)$  is called a *sub-hypergraph* of  $H$ . The *degree* of a vertex  $i$  of  $H$  is defined as  $d_i = |E_i|$ , where  $E_i$  denotes the set of edges containing  $i$ . The *rank* and *co-rank* of  $H$  is the maximum and minimum cardinality of an edge in  $H$ , respectively [1]. Let  $r(H)$  and  $cr(H)$  denote the rank and co-rank of  $H$ , respectively. If  $r(H) = cr(H) = k$ , then  $H$  is called *k-uniform*. 2-uniform hypergraphs are ordinary graphs. A *path* in a hypergraph  $H$  is defined to be an alternating sequence  $u_1 e_1 u_2 \cdots u_l e_l u_{l+1}$ , where  $u_1, \dots, u_{l+1}$

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