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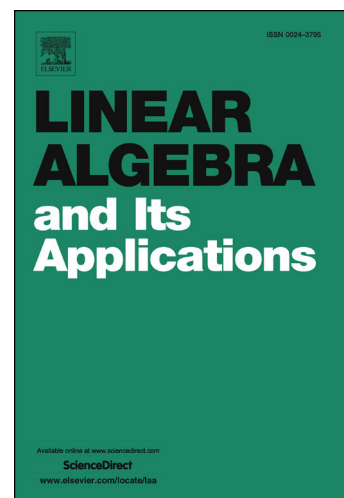
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Zero-nonzero patterns of order $n \geq 4$ do not require \mathbb{H}_n^*

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Abstract

In [1], the set of refined inertias \mathbb{H}_n for sign patterns is expanded to \mathbb{H}_n^* for zero-nonzero patterns. Also, it is proved that there are no zero-nonzero patterns of even order $2m$ that require \mathbb{H}_{2m}^* . In this paper, it is shown that there are no zero-nonzero patterns of odd order $n \geq 5$ that require \mathbb{H}_n^* , which together with the previous result prove that there are no zero-nonzero patterns of order $n \geq 4$ that require \mathbb{H}_n^* .

AMS classification: 15B35, 15A18, 05C50, 05C20

Keywords: Eigenvalues; Refined inertia; Zero-nonzero pattern; Digraph.

1 Introduction

The set of refined inertias \mathbb{H}_n is relevant to the study of dynamical systems, where the presence of nonzero pure imaginary eigenvalues can signal the onset of periodic solutions by Hopf bifurcation ([2]). Previous papers ([2]–[6] and references therein) have focused on sign patterns that require or allow \mathbb{H}_n . Recently, in [1], the concept \mathbb{H}_n for sign patterns is expanded to \mathbb{H}_n^* for zero-nonzero patterns.

An $n \times n$ *sign pattern (matrix)* is an $n \times n$ matrix whose entries come from the set $\{+, -, 0\}$. For a real matrix B , $\text{sgn}(B)$ is the sign pattern matrix obtained by replacing each positive (resp., negative) entry of B by $+$ (resp., $-$). For an $n \times n$ sign pattern matrix \mathcal{A} , the qualitative class of \mathcal{A} , denoted $Q(\mathcal{A})$, is defined as $Q(\mathcal{A}) = \{B \in M_n(\mathbb{R}) \mid \text{sgn}(B) = \mathcal{A}\}$. Two sign patterns are said to be *equivalent* if one can be obtained from the other by any combination of transposition, signature similarity, and permutation similarity.

An $n \times n$ *zero-nonzero pattern* is an $n \times n$ matrix \mathcal{A} with entries from $\{*, 0\}$, where $*$ is nonzero. A real matrix $B = (b_{ij})$ is a *realization* of \mathcal{A} if $b_{ij} \neq 0$ if and only if the corresponding entry of \mathcal{A} is $*$. The *zero-nonzero pattern class* $Q(\mathcal{A})$ is the set of all realizations of \mathcal{A} . Two zero-nonzero patterns are *equivalent* if one can be obtained from the other by any combination of transposition and permutation similarity.

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