

## Several Spectrally Non-Arbitrary Ray Patterns of Order 4

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**Abstract :** A matrix is called a ray pattern matrix if its entries are either 0 or a ray in complex plane which originates from 0. A ray pattern  $A$  of order  $n$  is called spectrally arbitrary if the complex matrices in the ray pattern class of  $A$  give rise to all possible  $n$ th degree complex polynomial. Otherwise, it is said to be spectrally non-arbitrary ray pattern. We call that a spectrally arbitrary ray pattern  $A$  of order  $n$  is minimally spectrally arbitrary if any nonzero entry of  $A$  is replaced, then  $A$  is not spectrally arbitrary. In this paper, we find that is not spectrally arbitrary when  $n$  equals to 4 for any  $\theta$ ; which is greater than or equal to 0 and less than or equal to  $n$ . In this article, we give several ray patterns  $A(\theta)$  of order  $n$  that are not spectrally arbitrary for some  $\theta$ ; which is greater than or equal to 0 and less than or equal to  $n$ . by using the nilpotent-Jacobi method. One example is given in our paper.

**Keywords :** spectrally arbitrary, nilpotent matrix , ray patterns, sign patterns

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