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Completely Positive Cones: Are They Facially Exposed?

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Abstract

Whether the $n \times n$ completely positive cone for $n \geq 5$ is facially exposed is an open problem raised by Berman, *et. al.* in 2015. In this paper, we give a class of non-exposed faces of the 5×5 completely positive cone, which implies that the 5×5 completely positive cone is not facially exposed. By embedding the 5×5 completely positive cone into the $n \times n$ completely positive cone for $n > 5$, we further show that the $n \times n$ completely positive cone is not facially exposed for $n > 5$.

Keywords: Completely Positive Cones, Copositive Cones, Faces, Facially Exposed Cones

2010 MSC: 15B48, 15A23, 15B99, 52A20

1. Introduction

The copositive cones and their dual cones, namely the completely positive cones, have many applications, and have been topics of research for many years (see [1] [2]). However, due to their complicated structures, knowledge about the geometric aspects (especially facial structures) of the copositive cones and completely positive cones are very limited. In [3], a way of representing all the maximal faces of the copositive cones along with a simple equation for the dimension of each one was given because of the known representations of exposed rays of the completely positive cones. Also in [3] some maximal faces (not all maximal faces) of the completely positive cones and their dimensions were

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