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Foundations for a theory of complex matroids. (English) Zbl 1256.05036

Summary: We explore a combinatorial theory of linear dependency in complex space, complex matroids, with foundations analogous to those for oriented matroids. We give multiple equivalent axiomatizations of complex matroids, showing that this theory captures properties of linear dependency, orthogonality, and determinants over \( \mathbb{C} \) in much the same way that oriented matroids capture the same properties over \( \mathbb{R} \). In addition, our complex matroids come with a canonical \( S^1 \) action analogous to the action of \( \mathbb{C}^* \) on a complex vector space.

Our phirotopes (analogs of determinants) are the same as those studied previously by A. Below, V. Krummeck, and J. Richter-Gebert [Algorithms Comb. 25, 203–233 (2003; Zbl 1077.52521)] and E. Delucchi [On generalizing oriented matroids to a complex setting. ETH Zurich (Diploma Thesis) (2003)].

We further show that complex matroids cannot have vector axioms analogous to those for oriented matroids.

MSC:
- 05B35 Combinatorial aspects of matroids and geometric lattices
- 52C40 Oriented matroids in discrete geometry

Keywords:
- matroids; oriented matroids; complex matroids; phirotopes

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References:


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