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Costas cubes

A Costas array is a permutation array for which the vectors joining pairs of 1s are all distinct. We propose a new three-dimensional combinatorial object related to Costas arrays: an order n *Costas cube* is an array $(d_{i,j,k})$ of size $n \times n \times n$ over $\mathbb{Z}_2$ for which each of the three projections of the array onto two dimensions, namely $(\sum_i d_{i,j,k})$ and $(\sum_j d_{i,j,k})$ and $(\sum_k d_{i,j,k})$, is an order n Costas array. We present constructions for two infinite families of Costas cubes. We determine all Costas cubes of order at most 29, showing that Costas cubes exist for all these orders except 18 and 19 and that a significant proportion of the Costas arrays of certain orders occur as projections of Costas cubes. We then present constructions for two infinite families of Costas cubes.

This is joint work with Lily Yen, Capilano University.