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Tilings with optimal constant-weight codes

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Tilings with optimal constant-weight codes

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Abstract

The metric space $\mathcal{H}_q(n,w)$ is the set of all words of length n with weight w over the alphabet $\mathbb{Z}_q$, under the Hamming distance metric. A q-ary constant-weight code, as a nonempty subset of $\mathcal{H}_q(n,w)$, has always been a fundamental topic in coding theory. This talk investigates the tiling problem of $\mathcal{H}_q(n,w)$ with optimal $(n,d,w)_q$-codes, simply denoted by $\mathrm{TOC}_q(n,d,w)$, meaning a partition of $\mathcal{H}_q(n,w)$ into mutually disjoint optimal q-ary constant-weight codes with distance d. When the distance d is odd, we investigate large sets of generalized Steiner systems. When d is even, we define large sets of generalized maximum H-packings. We present several general construction approaches for generating $\mathrm{TOC}_q(n,d,w)$s via t-resolvable Steiner systems and almost-regular edge-colorings of complete hypergraphs. For the cases $d=2$ and $d=2w$, we completely resolve the existence problem of $\mathrm{TOC}_q(n,d,w)$s for all parameters q,n and w. Particularly, we pay attention to tilings for weight three. For binary case and weight three, the existence problem of $\mathrm{TOC}_2(n,d,3)$s is totally resolved. For specific alphabet size $q\geq 3$, we obtain many infinite families of $\mathrm{TOC}_q(n,d,3)$s for distances $d=3,4,5$. This is a joint work with Yuli Tan.

Keywords: Constant-weight code, Generalized Steiner system, Large set, Almost-regular edge-colorings