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Abstracts

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PREFACE

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On the self-dual [42,21,8] codes

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If C is an optimal binary self-dual code of length 42, then its minimum weight is 8 and it has an weight enumerator

$$W_1 = 1+(84+8\beta)y^8+(1449-24\beta)y^{10}+(10640-16\beta)y^{12}+\cdots, \ 0 \le \beta \le 60$$

or $W_2(y) = 1+164y^8+697y^{10}+\cdots+y^{42}$ (see [1]). A code with the second weight enumerator is known. Using different techniques, many authors have constructed SD codes with weight enumerator W_1. But for all these codes $\beta = 0,1,\ldots,22$, 24, 26, 28, 32, or 42.

Using the shadow of a self-dual code, and bounds for the cardinality of equidistant codes, we prove the following result:

Theorem 1 *If C is a binary self-dual $[42,21,8]$ code with weight enumerator W_1 then $\beta = 42, 32, 28, 26, 24$, or $\beta \le 22$.*

References

[1] J. H. Conway and N. J. A. Sloane, A new upper bound on the minimal distance of self-dual codes, *IEEE Trans. Inform. Theory* **36** (1990), 1319–1333.

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Bounds on the covering radius of spherical designs

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We apply polynomial methods to obtain bounds on the covering radius of spherical designs [1] as function of their strength and cardinality. Earlier, Fazekas and Levenshtein [2, Theorem 2] proved that if C is a $(2k-\varepsilon)$-design with covering radius t_c, then $t_c \ge t_{FL} = t_k^{0,1-\varepsilon}$, where $t_k^{0,1-\varepsilon}$ is the largest zero of the Jacobi polynomial $P^{(\alpha,\beta)}(t)$, $\beta = \frac{n-3}{2}$, $\alpha = \frac{n-3}{2}+1-\varepsilon$. We obtain upper bounds on t_c by using suitable polynomials in the following theorem.

Theorem 1. *Let $f(t)$, $\deg(f) \le \tau$, be real polynomial which is nonnegative in $[-1,1]$. Then for every τ-design $C \subset \mathbb{S}^{n-1}$ we have $t_c \le m_u$, where m_u is the largest root of the equation $nf(t) = f_0|C|$ ($2nf(t) = f_0|C|$ for antipodal designs).*

The best polynomials still must be found. We prove that they have many double zeros.

Theorem 2. *The best polynomials for use in Theorem 1 are $f(t) = (t+1)^\varepsilon A^2(t)$, where $\tau = 2k-\varepsilon$, $\varepsilon \in \{0,1\}$, $\deg(A) = k-\varepsilon$ and $A(t)$ has $k-\varepsilon$ zeros in $[-1,t_{FL}]$.*

References

[1] P. Delsarte, J.-M. Goethals, J. J. Seidel, Spherical codes and designs, *Geom. Dedicata* 6, 1977, 363-388.

[2] G. Fazekas, V. I. Levenshtein, On upper bounds for code distance and covering radius of designs in polynomial metric spaces, *J. Comb. Theory A*, 70, 267-288 (1995).