

Abstract

**Some optimal codes related to graphs invariant under
the alternating group A_8**

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The simple alternating group A_8 , acts as a primitive rank-3 group of degree 35 on the set \mathcal{P} of lines of $V_4(2)$ with point stabilizer isomorphic to $2^4 : (S_3 \times S_3)$ with orbits of length 1, 16 and 18 respectively. Consequently this action defines strongly regular graphs Γ with parameters $(35, 16, 6, 8)$ and its complement $\bar{\Gamma}$ with parameters $(35, 18, 9, 9)$. The binary code of Γ is a two-weight code and thus using the codewords of minimum weight in the code we obtain a strongly regular graph with parameters $(64, 35, 18, 20)$ whose complement is a $(64, 28, 12, 12)$. The latter graph is a 2 -(64, 28, 12) design with the symmetric difference property, while $\bar{\Gamma}$ is as a symmetric 2 -(35, 18, 9) design. Further we construct a unique 2 -(35, 17, 8) Hadamard design as a complement of $\bar{\Gamma}$ having A_8 as a non-abelian socle and acting rank-3 on points and blocks. This design is extendable to a unique 3 -(36, 18, 8) design invariant under A_8 . Taking the row span over \mathbb{F}_2 and \mathbb{F}_3 of the adjacency matrices of the graphs or incidence matrices of the designs we construct binary (resp. ternary) self-orthogonal codes invariant under A_8 . We establish some properties of the codes and the nature of some classes of codewords. Some of the codes are optimal or near optimal for the given length and dimension.