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A construction of strength-4 covering arrays using three k-caps in $PG(3, q)$

A covering array, denoted by CA$(N; t, k, v)$, is an $N \times k$ array over an alphabet with v symbols with the property that for any t-set of column indices $\{c_1, \ldots, c_t\}$, each t-tuple of the alphabet occurs at least once as a row of the sub-array indexed by $c_1, \ldots, c_t$. Here, N is the size, and t is the strength of the covering array.

Raaphorst, Moura, and Stevens (2014) give a construction for a CA$(2q^3 - 1; 3, q^2 + q + 1, q)$, for any prime power q. This is obtained by two projective planes $PG(2, q)$ such that any three collinear points in one is mapped to three non-collinear points in the other.

A k-cap of $PG(m - 1, q)$ is a set of k points no three of which are collinear. In $PG(3, q)$, an ovoid is a k-cap with maximum size of k. In a paper by Tzanakis, Moura, Panario, and Stevens (2016), a CA$(511; 4, 17, 4)$ is constructed, which was formed by two ovoids in $PG(3, 4)$ such that any four coplanar points in one is mapped to four non-coplanar points in the other.

In this talk, we give a construction for strength-4 covering arrays using three k-caps in $PG(3, q)$, which has been verified for all odd prime powers q such that $3 \le q \le 101$. We conjecture that our construction is valid for any odd prime power q. This is joint work with Lucia Moura.