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Systems of Parallel Representatives

In a finite affine plane of order n , a *system of parallel representatives* (SPR) is a set of $n + 1$ lines consisting of exactly one line from each parallel class of the plane. An SPR is *tight* if no three of its lines are incident on a common point; this is equivalent to a hyperoval in the dual of the associated projective plane of order n . We describe some basic properties of SPR's and characterize tight SPR's as those on which a certain sum-of-squares function attains the value zero. We then examine some necessary conditions for an SPR to be minimal with respect to this function, and apply our results to SPR's in a hypothetical affine plane of order 12.