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**DIPARTIMENTO DI INGEGNERIA E SCIENZA DELL'INFORMAZIONE**

38123 Povo – Trento (Italy), Via Sommarive 14
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# Rectangular Thinned Array Design by McFarland Difference Sets

G. Oliveri, F. Caramanica, P. Rocca, and A. Massa

ELEDIA Research Group at DISI, University of Trento, via Sommarive 14, I-38123, Trento, Italy

The problem of reducing the number of elements of large arrays is of great importance in satellite, remote sensing, radar and biomedical imaging applications in which the cost, weight, power consumption, mutual coupling effects, HW and SW complexity have to be as low as possible. Thinned arrays, however, are known to exhibit high peak sidelobe levels (*PSL*) if not suitably designed [1]. As a consequence, design techniques able to control and reduce the PSL of non-regular arrays have been subject of research since their introduction [1]-[5].

Random designs were among the first methodologies to be applied, due to their simplicity and their good performances [1]. Such approaches have been overcome only by the introduction of stochastic optimization techniques [1], which, however, can be computationally unfeasible for very large arrays, and do not allow *a-priori* estimate of their performances [1]. More recently, an innovative deterministic technique able to provide good and predictable performances with very low computational efforts has been proposed for the thinning of large arrays [1]. Such technique, which exploits the two-level autocorrelation function of binary sequences derived by *difference sets* (DSs), has been shown to provide predictable advantages in terms of PSL with respect to the corresponding random designs, both for linear and for square and almost-square designs [1]. Moreover, an extension of such an approach, based on Almost Difference Sets, has allowed its application in a significantly wider set of configurations [2][3]. However, no rectangular DS (or ADS) designs with very different resolutions in the two angular directions have been investigated at present, despite the practical importance of such arrays in radar and remote sensing applications.

In this paper, the performances of a new class of DS-based thinned arrays will be investigated. The thinned geometries will be deduced by McFarland DSs [4], which are a class of non-cyclic DSs defined over a $p \times p(p+2)$ lattice (with $p$ a prime number). The accuracy of the available PSL estimators will be assessed by means of an extensive numerical validation, and comparisons with state-of-the-art thinning techniques will be provided as well.

## REFERENCES

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