The joint virtual event of the
African Light Source AfLS-2023 (6th)
and the
African Physical Society AfPS2023

Contribution ID: **101** Type: **not specified**

A Novel Sparse Linear Array via Maximum Interelement Spacing Concept for DOA Estimation Applications

Wednesday, 15 November 2023 11:30 (15 minutes)

Array signal processing is a field of signal processing that utilizes sensor arrays to detect incoming environmental signals and infer the signal's information, such as direction-of-arrival (DOA), signal power, amplitude, etc. Hence, it has numerous applications in automotive radar, astronomy, tomography, imaging, and wireless communication [1]-[3]. Recently, sparse linear arrays (SLAs) have gained considerable attention due to their enhanced degrees of freedom (DOF) [1]. Given the concept of difference coarray (DCA), these SLAs retain an $\mathcal{O}(N^2)$ long central uniform linear array (ULA) segment in their DCA, which boosts their DOF, making them capable of resolving $\mathcal{O}(N^2)$ uncorrelated sources using only N physical sensors. On the contrary, traditional uniform linear arrays (ULAs) can estimate only $N-1$ sources with the same N sensors. Besides, the large interelement spacings (IES) in SLAs reduce the mutual coupling (MC) effect [1], [3]. On this basis, several SLAs been proposed in [1]-[3] and references therein. In Ref. [1], an SLA with enhanced DOF and reduced MC effect, called the improved maximum IES constrained (IMISC) array, was introduced. However, according to [1, Appendix A], the IMISC array has missing virtual sensors in its DCA; therefore, the realized DOF is not as optimal as expected [2]. Inspired by IMISC, this paper proposes a new extended IMISC (xMISC) via a hole-filling strategy to recover the lost DOF. The strategy leverages IES adjustment, as demonstrated in [2, 3]. Numerical examples demonstrate the merits of the xMISC array over existing SLAs.

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Session Classification: Partner

Track Classification: Partner