Abstract

In this research work, we develop a number of sparse array configurations for direction-of-arrival (DOA) estimation for fixed and moving platforms. We know that DOA estimation is an important part of the array signal processing and there are subspace based and non-subspace based techniques in DOA estimation. Multiple SIgnal Classification (MUSIC) is a popular subspace based technique in DOA estimation. By applying the spatial smoothing technique in the MUSIC, we can explore the difference coarray of the sparse array. So, by properly placing the elements of the sparse array, we can estimate more sources than the number of sensors. Here, we propose various novel sparse array configurations utilizing the spatial smoothing MUSIC. The proposed arrays have attractive properties like achieving more degrees-of-freedom (DOF) and less mutual coupling among the sensors. We provide the closed form expression of the sensor locations of each of the proposed arrays and find the number of uniform DOF it attains. We can also utilize the sum coarray along with the difference coarray if we apply the vectorized conjugate augmented MUSIC (VCAM) algorithm, which explores the temporal and spatial information of the sources. We develop different sparse array configurations applying the VCAM algorithm and providing interesting features. The sparse arrays can also be on the moving platform. We look into the moving sparse arrays and propose some array configurations for half wavelength array motion. The proposed moving sparse arrays obtain considerable DOF. The optimization of the proposed arrays is carried out so that they achieve the maximum DOF for a specific number of sensors. The performance of each of the proposed arrays is evaluated by looking into its spatial spectrum and estimation accuracy. Root mean square error (RMSE) is considered to be the performance metric of the estimation accuracy. The RMSE versus the signal-to-noise ratio (SNR) and the RMSE versus the number of snapshots plots are provided for the proposed arrays.

Index Terms: DOA estimation, MUSIC, DOF, nested array, coprime array, moving array.