Hourglass Arrays and Other Novel 2-D Sparse Arrays With Reduced Mutual

Abstract:

Linear [one-dimensional (1-D)] sparse arrays such as nested arrays andminimum redundancy arrays have hole-free difference coarrays with O(N2) virtual sensor elements, where N is the number of physical sensors. The hole-free property makes it easier to perform beamforming and DOA estimation in the coarray domain which behaves like an uniform linear array. The O(N2) property implies that O(N2) uncorrelated sources can be identified. For the 2-D case, planar sparse arrays with hole-free coarrays having O(N2) elements have also been known for a long time. These include billboard arrays, open box arrays (OBA), and 2-D nested arrays. Their merits are similar to those of the 1-D sparse arrays mentioned above, although identifiability claims regarding O(N2) sources have to be handled with more care in 2-D. This paper introduces new planar sparse arrays with hole-free coarrays having O(N2) elements just like the OBA, with the additional property that the number of sensor pairs with small spacings such as λ/2 decreases, reducing the effect of mutual coupling. The new arrays include half-open box arrays, half-open box arrays with two layers, and hourglass arrays. Among these, simulations show that hourglass arrays have the best estimation performance in presence of mutual coupling.