Subspace Intersection Tracking Using GSVD and the Signed URV Algorithm

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We consider the separation of partially overlapping data packets by an antenna array in narrowband communication systems. This problem occurs in asynchronous communication systems and several transponder systems such as RFID, AIS and ADS-B. Arbitrary arrival times of interfering data packets cause nonstationary scenarios and makes it difficult to identify the interfering signals using standard blind beamforming techniques.

We propose subspace-based algorithms to suppress the intermittent interference. The algorithms are based on subspace intersection and oblique projections, and computed using generalized SVD (GSVD) and generalized eigenvalue (GEV) decompositions.

In the second part of the talk, these algorithms are refined using a recently developed subspace estimation tool, the Signed URV algorithm, which is in the class of “Schur subspace estimators”. This class provides a complete parametrization of all “principal subspace estimates”, defined as the column spans of corresponding low-rank matrix approximants that lie within a specified 2-norm distance of a given matrix. The parametrization is in terms of a two-sided hyperbolic decomposition, which can be computed using hyperbolic rotations. Although such rotations are commonly associated with numerical instabilities, the proposed SURV algorithm implicitly imposes certain constraints such that important norm bounds are achieved that guarantee stability. The algorithm is also non-iterative and the decomposition can be updated efficiently (similar to QR updates), and downdated in exactly the same way. The subspace estimates are close to the principal subspace provided by the SVD (which is a special case within the class). As we will show, the decomposition can be used to implement a "truncated Generalized SVD".