Study of unification of suboptimum methods applied to STAP radars

Sébastien De Grève (research fellow), Fabian D. Lapierre and Jacques G. Verly
University of Liège, Department of Electrical Engineering and Computer Science
Sart-Tilman, Building B28, B-4000 Liège, Belgium
{sdegreve, F.Lapierre, Jacques.Verly}@ulg.ac.be

The use of a moving pulsed Doppler radar system to detect and localized slow moving targets is a problem of great interest [1]. The system works as follow, a train of coherent pulses is transmitted from a source and the corresponding returns are sensed at each of the elements of a linear antenna array. By studying Doppler and spatial frequencies of the recorded signal, it becomes possible to know if a target is present or not, in a particular direction and with a particular velocity.

Nevertheless, interferences are present and need to be rejected thanks to adaptive weights applied to the radar signal. The optimum determination of these weights in the presence of noise, clutter (and jamming) is the object of Space-Time Adaptive Processing (STAP).

The calculation of the optimum weights involves the inversion of a covariance matrix. For a large number of antenna elements and transmitted pulses, the inversion of the covariance matrix is computationally intensive and cannot be done in real time. Several authors (for instance [1,2,3]) have developed suboptimum techniques that exploit all the spatial and temporal samples, but avoid the brute-force inversion of the full-size covariance matrix.

Most of the suboptimum methods proposed are adhoc. The goal of this research is to see if all these methods, as well as new ones, can be described in terms of a common underlying structure. Said differently, we are looking for a common mathematical framework that can be specialized to obtain all suboptimum methods proposed so far.

References

[1] R. Klemm, "*Principles of space-time adaptive processing*", IEE Radar, Sonar, Navigation and Avionics 9, 2002.
[2] J. Ward, *"Space-Time Adaptive processing for airborne radar"*, Technical report 1015, Lincoln Laboratory MIT, December 1994.
[3] H. Wang, L. Cai, *"On adaptive Spatial-Temporal Processing for Airborne Surveillance Radar System"*, IEEE transactions on aerospace and electronic systems, vol. 30, no. 3, july 1994