Dictionary Learning for Maritime Radar Detection

Brian Ng[1] and Luke Rosenberg[2]

1: University of Adelaide

2: Defence Science and Technology Group, Edinburgh, SA, 5111

Target detection in the presence of sea clutter is a well-studied problem. Techniques such as sparse signal separation have been proposed in recent years to enhance detection performance. Previous approaches include wavelet transforms and frequency detection to sparsely represent the radar returns. This presentation discusses the use of custom dictionaries to sparsely represent the signals. There are two advantages to this approach. First, sparse representations condense each dataset into a small set of core information and offers robustness against fluctuations. Second, custom dictionaries are entirely data-dependent and is free of assumptions which underpin all predefined dictionaries. These properties are exploited in this work to explore the suitability of dictionary learning for target detection in maritime radar.

This work explores training dictionaries using clutter-only or target-only returns in the range-time domain. Simulated clutter and targets in X-band are used to explore a range of scenarios. The K-SVD algorithm is used to train dictionaries in all instances. It was found that target dictionaries offer efficient representations with few atoms, particularly when the dictionary is small. This approach led to modest gains in signal-to-interference ratio when false targets are injected into simulated clutter. Clutter-only dictionaries can be used to declutter a scene. In our experiments, such approaches yielded mixed results and generally led to lower gains than the target dictionaries.