

# Exploiting Diversity Gain Through MIMO Radar and Sonar Signal Processing

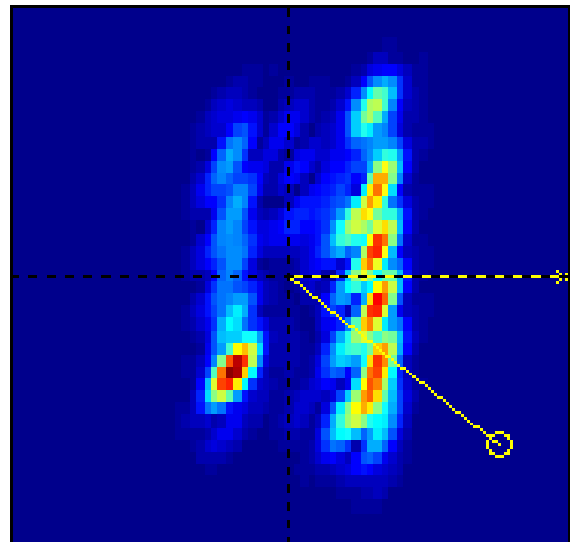
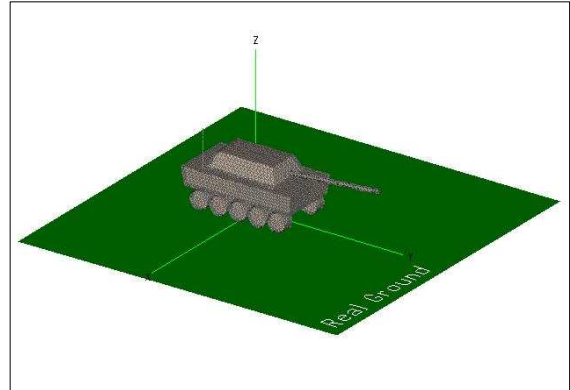
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## Proposed research and its context

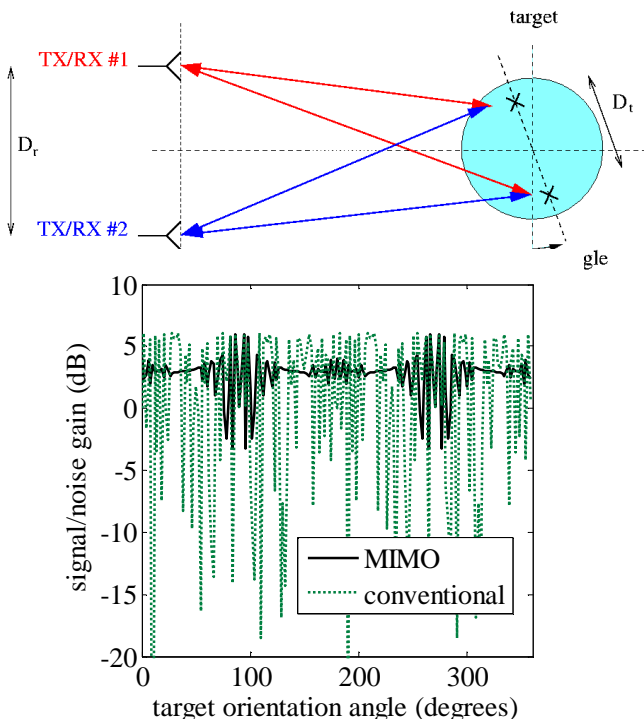
Since the emergence of the multiple input multiple output (MIMO) radar concept, there has been considerable international activity on the topic. This activity has focused both on the underlying theory, confirming the significant potential gains in detection and resolution performance that might be achieved, and on developing signal processing algorithms to facilitate these gains. What we propose here is to exploit the lead we have in (i) methodologies for calculating detection performance in realistic MIMO radar or sonar scenarios [1]; (ii) adaptive detection techniques for radar array-based signal processing that do not require secondary training data [2]. We address the open research questions whose solution will facilitate industrial exploitation of the MIMO radar concept. In particular these are: (i) the design of correlation controlled constant amplitude MIMO waveforms; (ii) the development of adaptive receiver algorithms capable of working in environments of unknown clutter statistics and within the constraints of limited bandwidth communication channels between individual TR/RX pairs. A further novel aspect of the work will be the application of and assessment of MIMO concepts in sonar environments.

## The overall aims are:

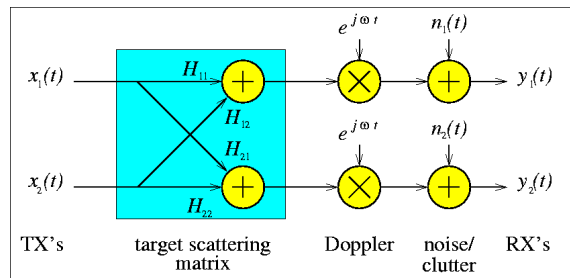
- To propose and study the effectiveness of MIMO transmission waveforms which are designed to meet practical constraints in radar transmit amplifiers;
- To develop and investigate the effectiveness of single dataset detection techniques for MIMO radar detection problems;
- To investigate the application of MIMO radar detection techniques to sonar systems by both computer simulation and experiment



**Figure 2:** Tank with CAD model (upper) and bistatic SAR image generated from EM modelling tool



**Figure 1:** MIMO target detection; (upper) simplified illustration of the basic concept; (lower) signal/noise gain as a function of target orientation angle



**Figure 3:** MIMO-radar pulsed-Doppler radar target model.

## References

- [1] Du, C.; Thompson, J. & Petillot, Y. (2008), 'Predicted Detection Performance of MIMO Radar', *IEEE Signal Processing Letters* 15, 83-86.
- [2] Aboutanios, E. & Mulgrew, B. (2009), 'A Generalised Hybrid STAP Approach For Radar Target Detection in Heterogeneous Clutter', *IEEE Transactions on Aerospace and Electronic Systems*, to appear.