Industry Signal Processing Challenges

Prof Malcolm Macleod

September 2014

The brief

The questions posed were:

1. What signal processing problems are the Defence industry wrestling with currently and what would make a real difference?

2. What are the constraints/systems-issues that prevent or delay the adoption of cutting-edge signal processing algorithms, and how could they be ameliorated?

Let's answer a different question first ☺ …

3. What does industry find most valuable from university research teams?

In our experience:

- Academics with deep and sufficiently broad knowledge (e.g. as consultants / collaborators)

- Capable and knowledgeable students (or PDRAs) (to employ)

- The fundamental advancement of understanding and invention of techniques (typically as a result of 2-3 year programmes not focussed on short term goals)

UNCLASSIFIED
QinetiQ Proprietary

Barriers to adoption

The second question was about barriers to adoption of signal processing advances:

- What are the constraints/systems-issues that prevent or delay the adoption of cutting-edge signal processing algorithms, and how could they be avoided?

Here are three major reasons – applicable even to <u>good</u> research outputs:

- The use of models of the physics (signal, noise, clutter, interference, propagation and so on) which are simplified and do not fully reflect real life signals and physics
- The lack of useful (i.e. sufficiently comprehensive) comparisons between the newly published method and previous ones
- The fact that the published algorithm is only ever one component of a more complicated overall algorithm which defines the operation of the whole system

QinetiQ Proprietary

Barriers to adoption (continued)

<u>Bad</u> (even useless) research outputs have worse defects :

- Completely unrealistic assumptions, which are never valid
- The lack of any relevant comparisons between the newly published method and previous ones

And then there is research which is not practically valuable, because it provides little advantage – "yet another algorithm to solve problem X" … "0.1dB improvement"

Or it is about a way to achieve x2 speed up using today's technology

- This has a very short shelf life – of little interest after 2 years

- It can never consider all the tradeoffs in engineering a whole system, so it is very rarely directly useful

However, generic research into (for example) how best to use GPUs or other specialised architectures can support a developing body of understanding on which engineering tradeoffs can be based for specific future developments

UNCLASSIFIED
QinetiQ Proprietary

Reducing barriers to adoption

The question is: can these barriers to adoption be reduced?

They can be reduced slightly, but not completely

- By carefully considering the physics (perhaps by discussion with domain experts) to try to capture enough of its important features

- But not making it so problem specific that the results are not widely useful

- By identifying what comparisons with previous methods might be valuable to someone wishing to evaluate the new method

But I don't believe that published research can realistically consider overall system design tradeoffs – it would be too much effort and the result would be too narrow, and transient

UNCLASSIFIED
QinetiQ Proprietary

And finally, question 1

Question 1 was: what signal processing problems are the Defence industry wrestling with currently and what would make a real difference?

There are of course very many

- The call for the first phase UDRC described 8 generic areas and listed 30 more-detailed specific "challenges"

- The call for the current UDRC described 10 major signal processing research themes and the two consortia proposed and are now investigating 100-200 specific problems within these themes

All of these might be highly relevant to current challenges or challenges that can be imagined in future

I don't know of any current challenges where there is "no solution". But advances will be of interest if they

- Help to improve capability, performance or SWAP of future systems

- Match evolving problems

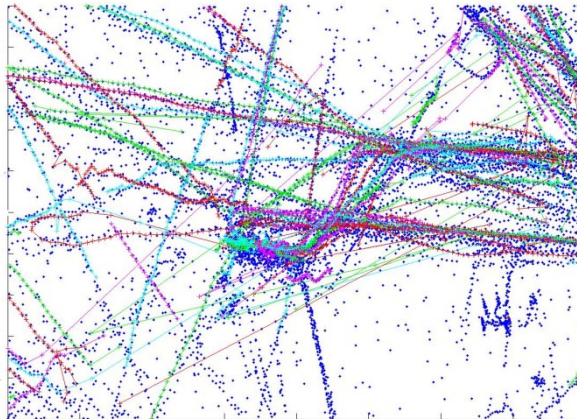# Examples of signal processing challenges

Broadband signal separation

Urban RF electronic surveillance challenges

Future communications – next generation military radios

Protection of communications, radar and electronic sensing from interference

Statistical anomaly detection

And there are plenty more

Thank you for your attention

Questions ?