

Resolving the Radar/Wind Farms Interaction

Geoff Butler Wind Farm Business Manager

Aviation Issues Session
ALL-ENERGY 2005

the power to see :

the information
to decide :

the knowledge
to command :

ORGANISATION

- BAE SYSTEMS
 - £14 bn turnover per annum, c80,000 people worldwide
 - Largest customers are US DoD and UK MoD

- INSYTE
 - Division of BAE Systems focussed on Systems Integration and Sensors incl Manufacture of Radars
 - c£500m turnover, 4000 employees, 10 sites in UK
 - Original Equipment Manufacturer of majority of UK ATC and AD Radars
 - Prior to 03/05/05 trading as 'AMS'

The Problems - general introduction

- Known effects of large windfarms on radar:
 - False plots caused by rotating blades breaking through the Doppler processing channels
 - Effects on sensitivity caused by extremely large bulk Radar Echoing Area of turbines (mainly the towers and nacelles)
- Effects are variable over time
 - The rate at which radar “samples” its environment strobos with turbine rotation
 - Wind direction affects the aspect angle of the turbines to the radars
 - Bending and deflection of structures with wind speed

Current Position

- ADT Demonstrator Programme underway (Joint funding AMS investment, BWEA membership and DTI)
- Greater Wash Study (DTI sponsored)
- Supported RAF Wind Farm Trials (both ATC and Air Defence)
- Continued development of ‘Wind Farm Toolbox’
- Specific Wind Farm projects for individual developers
- Close working relationship with Stakeholders

ADT Demonstration Programme

- Provide a live demonstration of ADT capabilities in the presence of existing wind farms
- RAF supply a Tactical Watchman ATC Radar
- Integrate an ADT, data recording systems and displays
- Deploy to a site in mid-Wales with views of 5 wind farms
- Analyse data to determine performance
- Use information gathered to tune the new algorithms and demonstrate benefits
- Display to show plot filtered data and processed video
- **Structured Formal Engagement of Stakeholder community**

Benefits

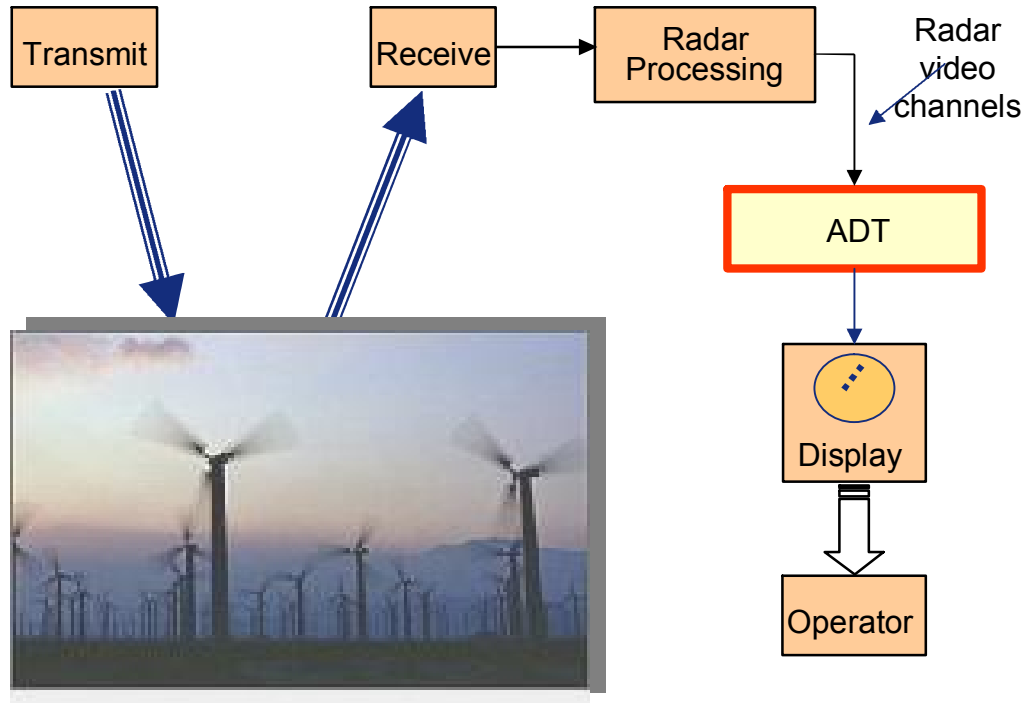
- Raise confidence levels with regulatory community that solution does exist to Radar/Wind Farm interaction problems.
- Provide practical evidence for future use of ADT at other radar sites
- Fully expandable algorithms to cope with additional turbines

The Advanced Digital Tracker (ADT)

A post-processor that can be added to an existing radar

More advanced than Plessex and other plot filters

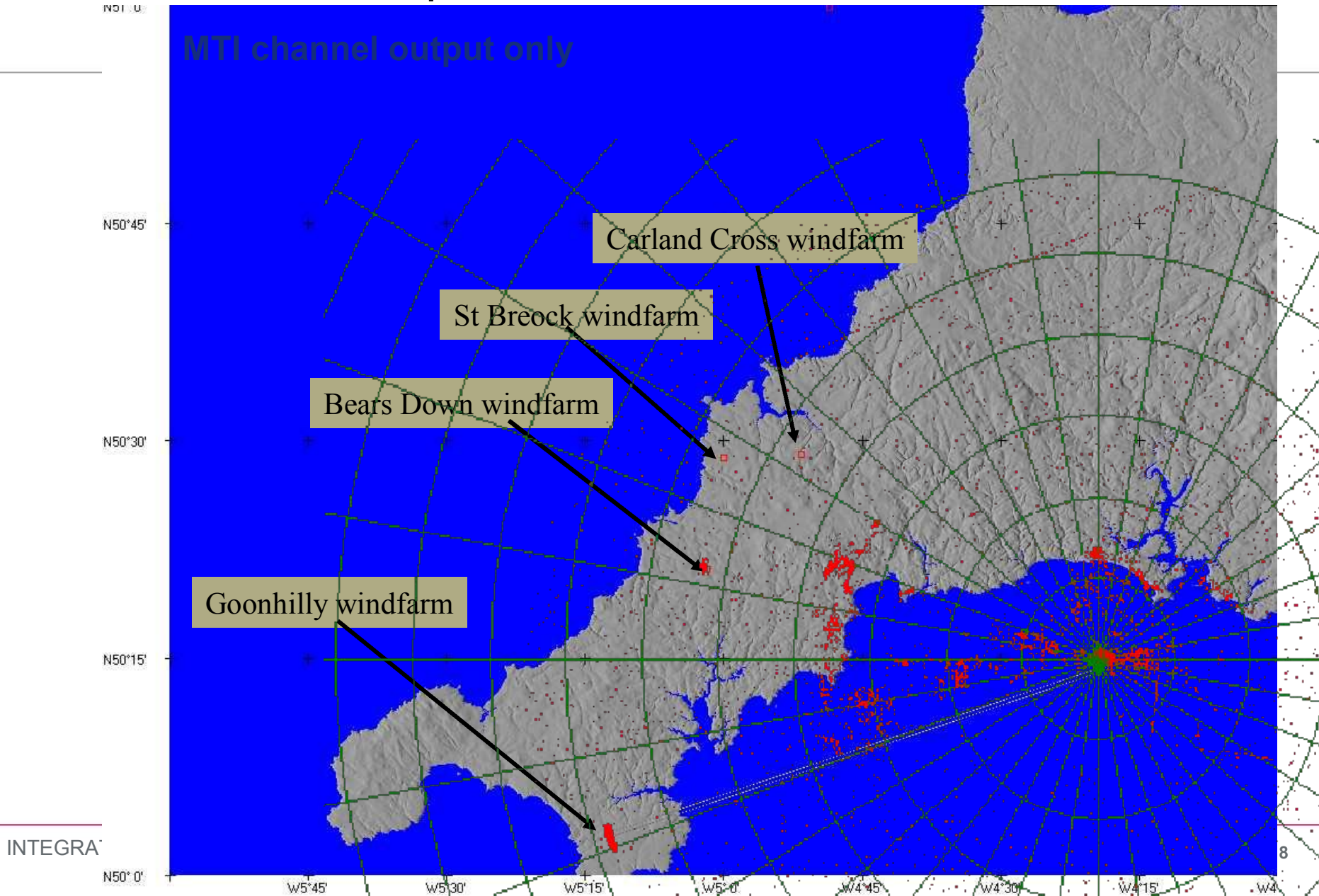
Based on our Naval track extractor family



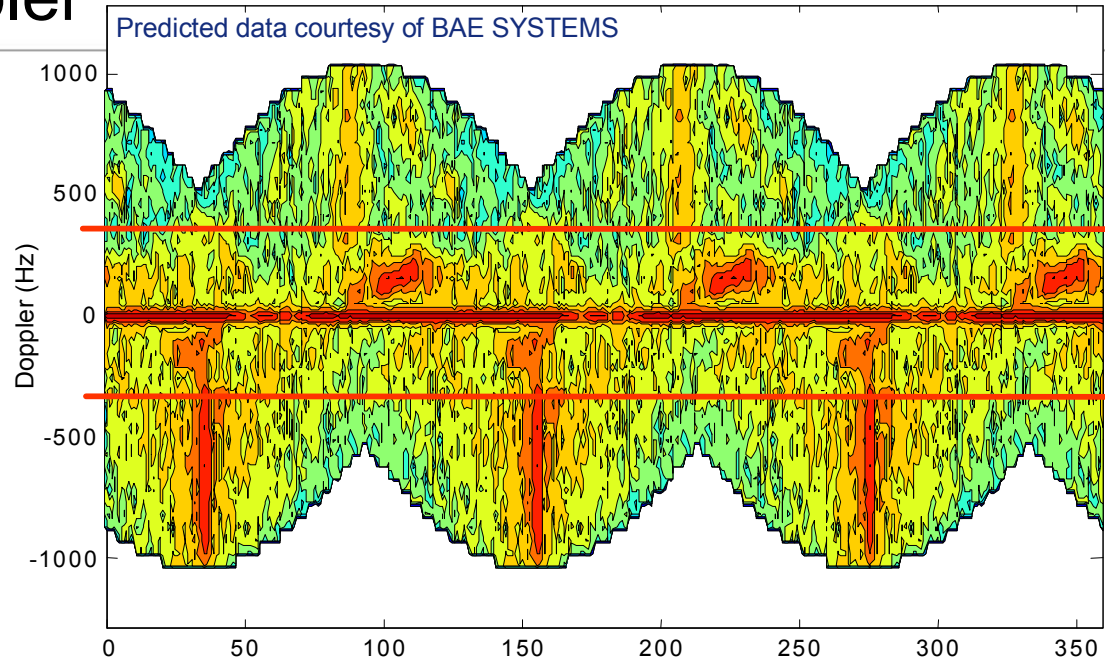
ADT helps in two ways:

- Reduces False plot rate
- Enables radar sensitivity to be increased without increasing false plot rate

The false alarm problem



Doppler



Example:

- 50m/sec tip speed
- S-Band radar

Doppler stop band for typical MTI filter

- Doppler is spread and covers the lower speed range expected of aircraft
- Variability due to turbine designs and operating conditions
- Future trends to higher tip speeds, especially offshore where acoustic noise is less of a problem
- Trend towards variable rotation speed

The Wind Farm 'Toolbox'

- Layout/Screening Solutions
 - Design the wind farm layout to be 'radar friendly':
 - turbine spacing, topology, turbine structure design, RCS management, etc
 - Screen the wind farm from the radar
- Radar Solutions
 - Adjust the radar settings to optimise performance
 - Modify the radar processing design
 - Add extra filtering to the radar (ADT plot filter)
 - Reinforce radar cover from existing or new sensor
- Turbine Solutions
 - Materials

Use appropriate methods

- Mitigation measures are site-dependent
 - Holistic treatment of the wind farm/radar interaction
 - Wind farm toolbox
 - Avoid problems if possible
 - Best set of measures for any situation should be chosen
 - Identify the significant issues – false alarm rate, loss of detection.....
 - Choose an appropriate solution
 - Robustness to varying wind farm parameters
- Today there is no “panacea” solution

BAE Systems support to wind farms

- We are active in finding solutions that allow wind farms to coexist with radar
- Programmes demonstration to the regulatory authorities
- Supporting developers through “Impact Assessment Studies” to identify issues before submitting plans

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