



IFT&E Summary and Wind – Radar Interference Mitigation R&D



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Wind Turbine Impacts

Turbines are growing in size and number



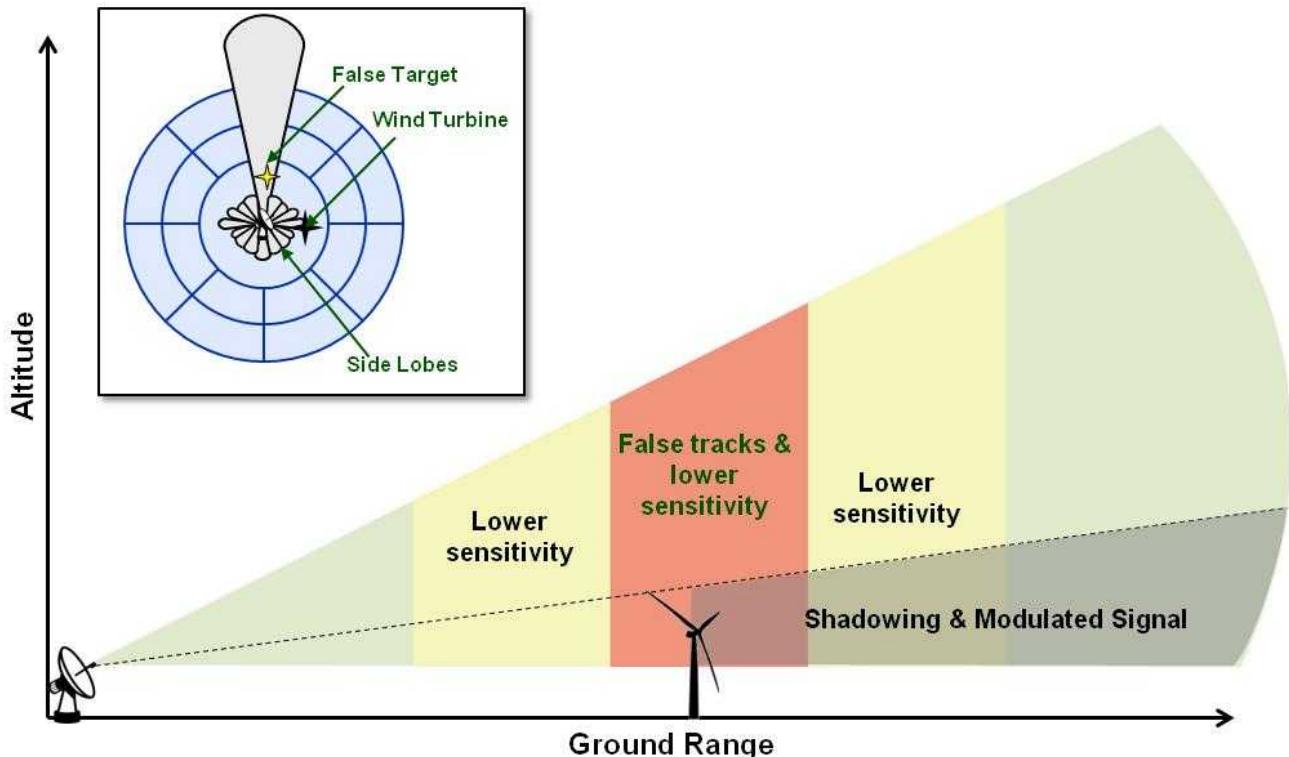
- Tip speeds over 225 mph
- Blades more than 50 m long
- 30 – 40 dBsm
- Wind farms with 100s of turbines

- Decreased Sensitivity (P_D)
- False Targets (P_{FA})
- Corrupted Track Quality



Concern for:

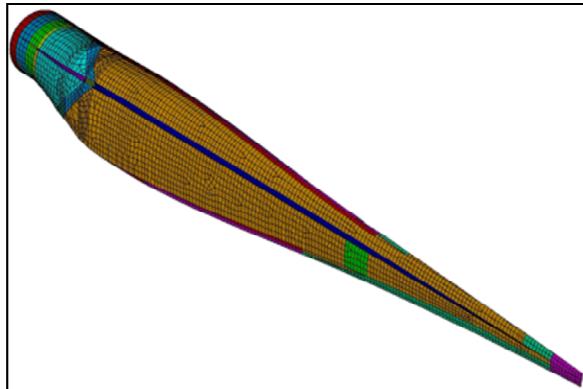
- Flight Safety
- Homeland Air Security





Industry Proposed Mitigation Options

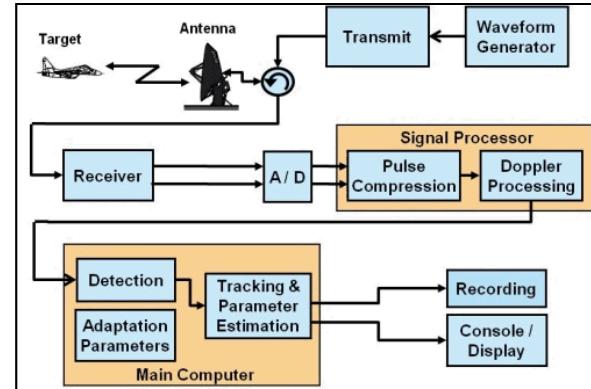
Reduced Signal Turbines



Replacement Radar



Radar Upgrades



Wind Farm Siting



Augmentation Radar



C2/Automation Upgrades





Interagency Field Test & Evaluation

Evaluate wind turbine impact and industry mitigations

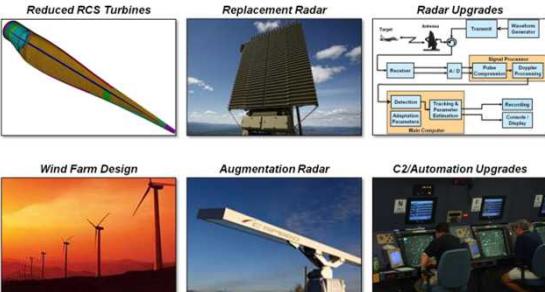


Steering Committee

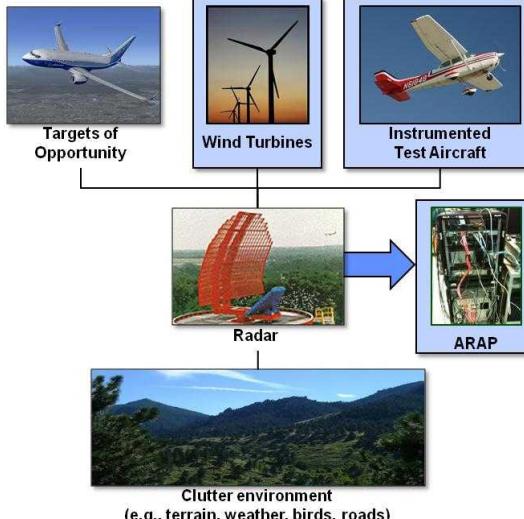
DOE, DoD, DHS, FAA



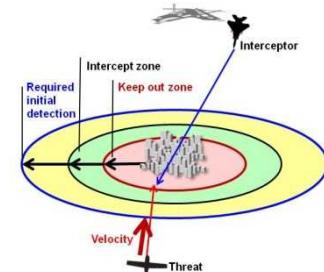
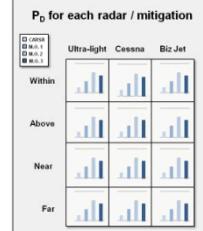
Industry Mitigations



Flight Tests & Analysis



System Analysis

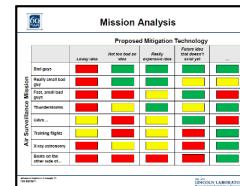


- 2-year, jointly funded program
- 3 flight campaigns
 - CARSR (Tyler, MN)
 - ASR-11 (Abilene, TX)
 - ARSR-4 (King Mountain, TX)
- Invite selected mitigations
 - Selected 11 concepts to assess
- System analysis of mission impact

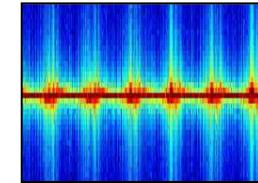
Interagency Field Test & Evaluation Products



Characterize Current Impact



Assess Proposed Mitigations

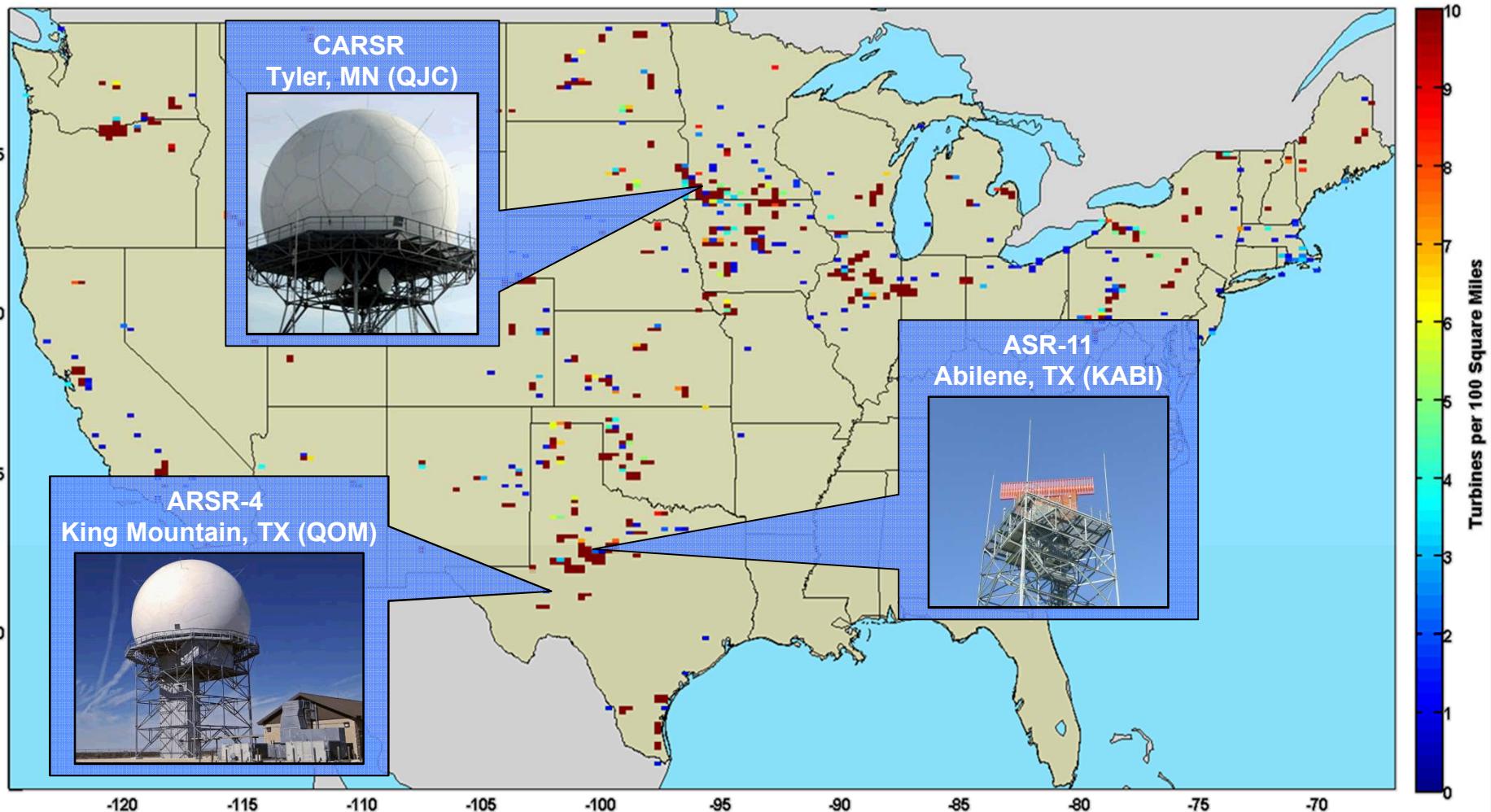


Data for Future R&D



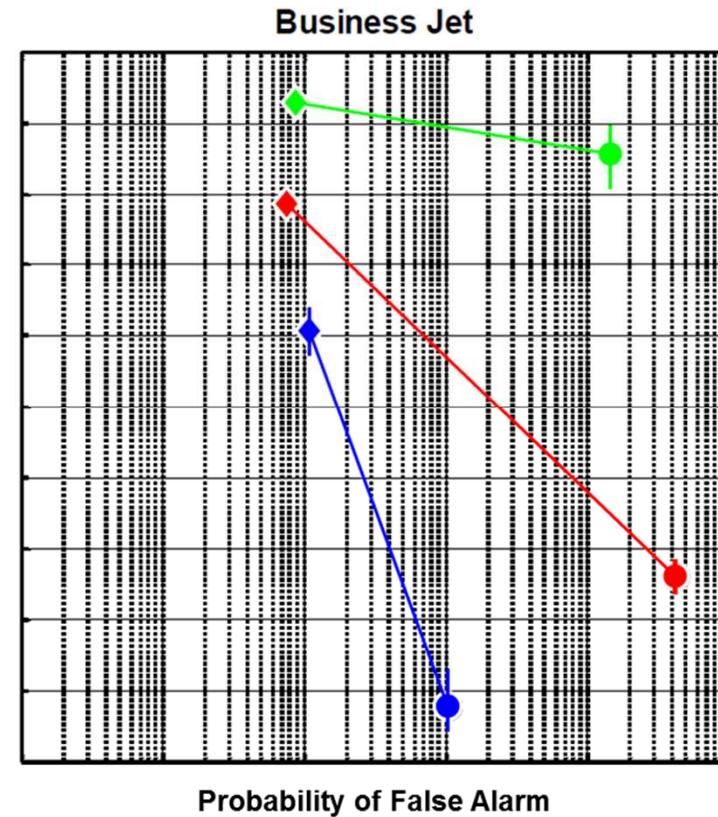
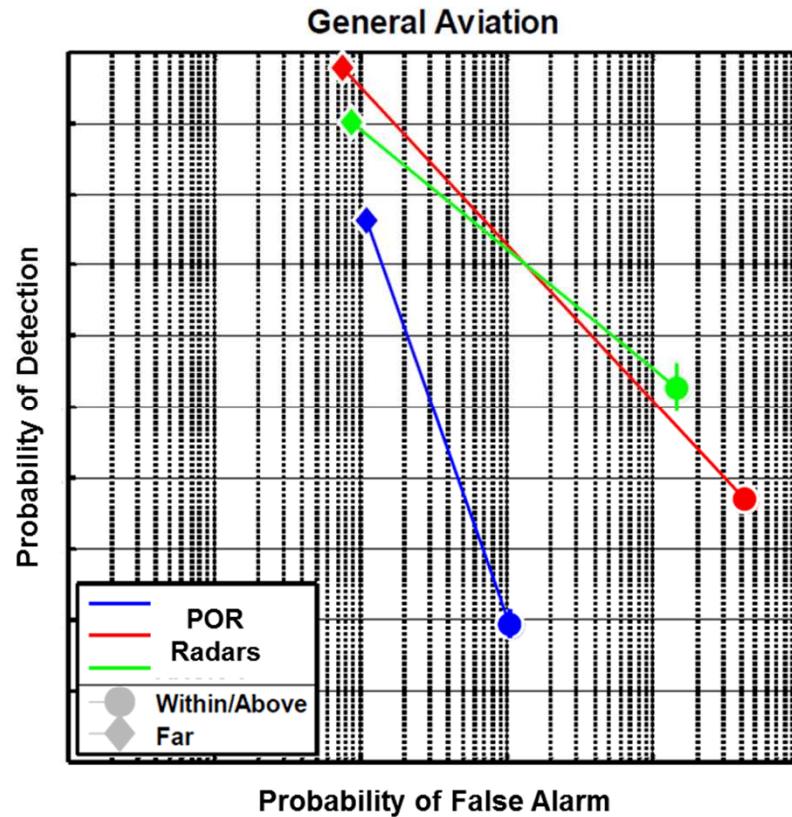


IFT&E Flight Campaigns





Performance of Existing Radars

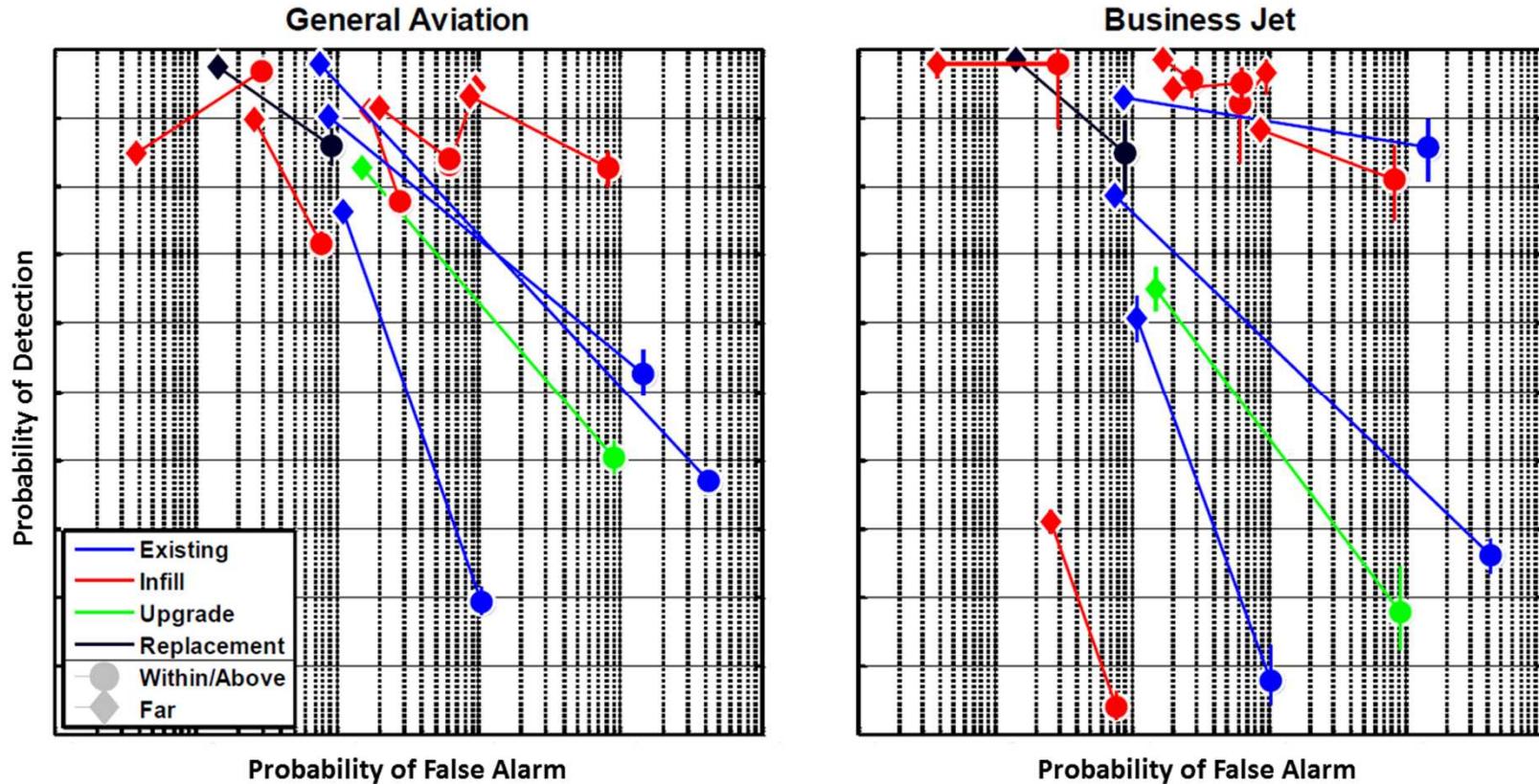


Existing primary surveillance radar performance significantly impacted in regions near and above operating wind turbines

SOURCE: IFT&E Industry Report: Wind Turbine – Radar Interference Test Summary, SAND2014-19003, Sep 2014
<http://energy.gov/eere/wind/downloads/interagency-field-test-evaluation-wind-turbine-radar-interference-mitigation>



Performance of Existing Radars and Tested Mitigations



All systems tested were impacted by wind turbines; however, many of the mitigation systems were significantly less impacted than existing radars

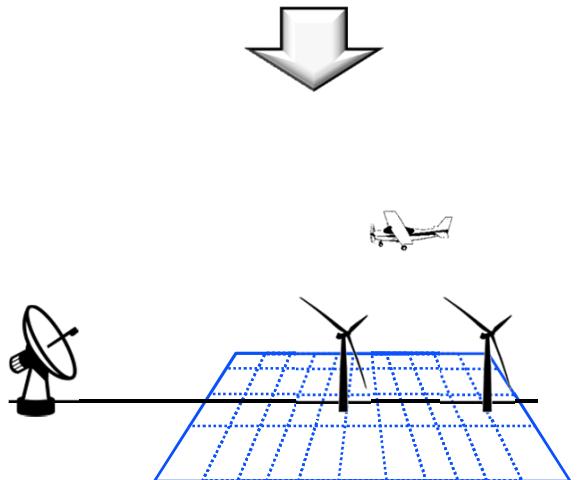
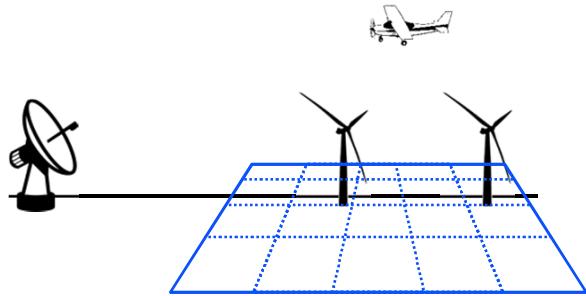
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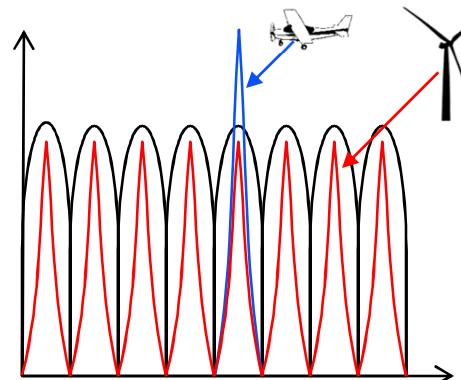
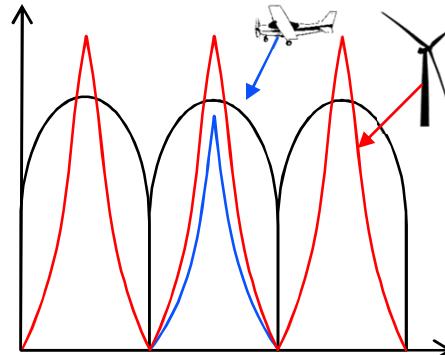
Radar Approaches to Improving Detection



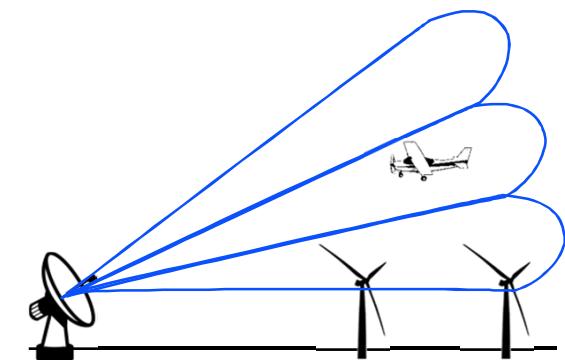
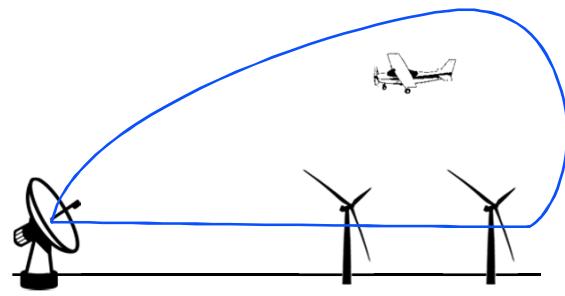
Improve Range Resolution



Improve Doppler Resolution



Improve Altitude Resolution

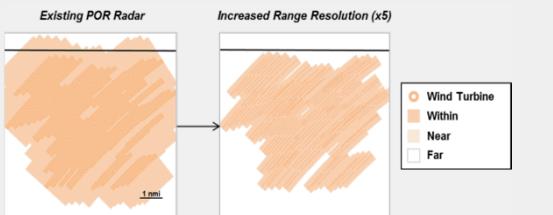
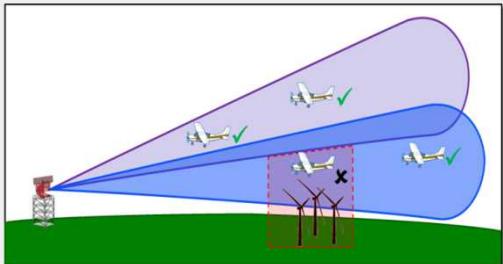




Interference Mitigation R&D Efforts

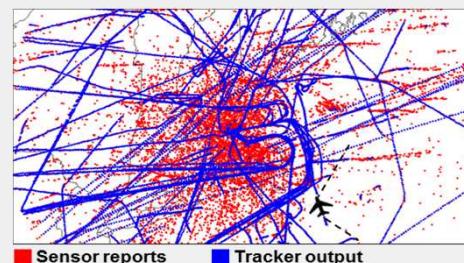


Existing Radar Algorithm Upgrades



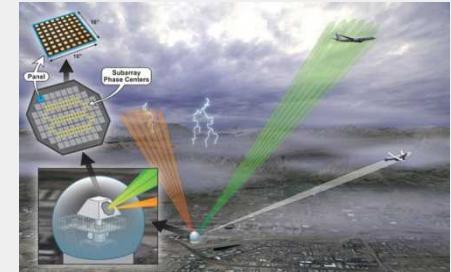
- Multi-beam turbine nulling
- Increased range resolution

C2/Automation Systems



- Radar network tuning
- Advanced sensor fusion

Future Systems



- Mitigation requirements for next-gen surveillance