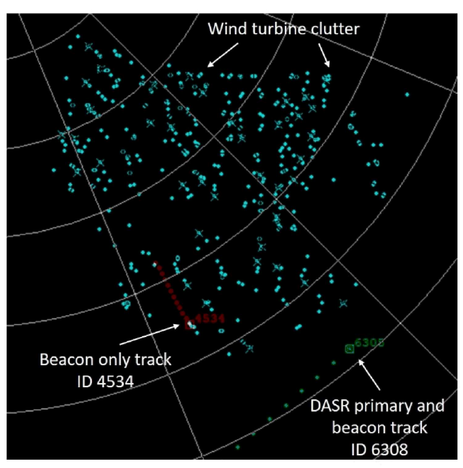
Sandia National Laboratories

SAND2020-3064C

Wind Turbine Interference on Radar Systems

Travis Air Force Base Pilot Mitigation Project



Screen capture from a software tool showing wind turbine clutter (blue dots). The red plot is a beacon-only track and the green plot is a DASR reinforced plot. Range rings are spaced at 2 nmi.

The Problem

Wind turbines are a problem for radar systems because they produce stationary and Doppler clutter. As the turbine blades spin their motion is detected in a radar as a moving object based on the Doppler return. The blades rotate at such a rate that the speed of a turbine, say at the tip, has a velocity commensurate with a small plane

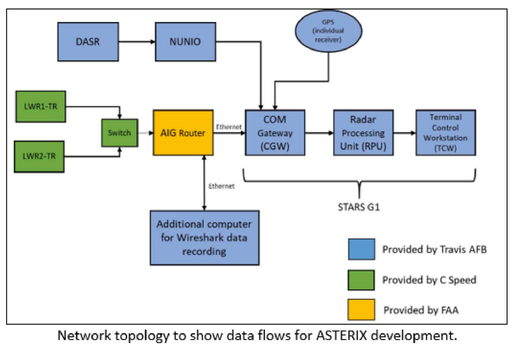
The Potential Mitigation

One possible solution to wind turbine clutter is to employ an infill radar for coverage over and around the wind resource area. This radar would have to detect aircraft in and around the wind resource area. In addition, this radar would have to reject any clutter from the wind turbines so the radar does not introduce its own clutter issues while trying to mitigate the clutter from the DASR. The infill radar must interface and work with STARS so ATC operators can control the WRA airspace.

Project Objectives

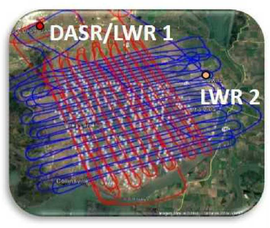
1. Deploy and Operate an infill radar to cover the WRA
2. Integrate the infill radar and the local radar into the STARS G1 platform
3. Collect data for radar and STARS system performance evaluation over the WRA
4. Use flight profiles to stress infill radar performance and STARS trackers
5. Explore radar siting and implementation for optimal results
6. Explore STARS operations and resulting screen display for air traffic controllers

Network Typology

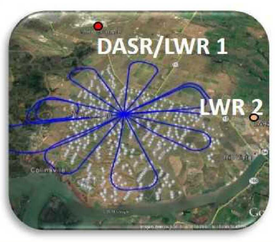


Network topology to show data flows for ASTERIX development.

Test Flight Pattern Examples

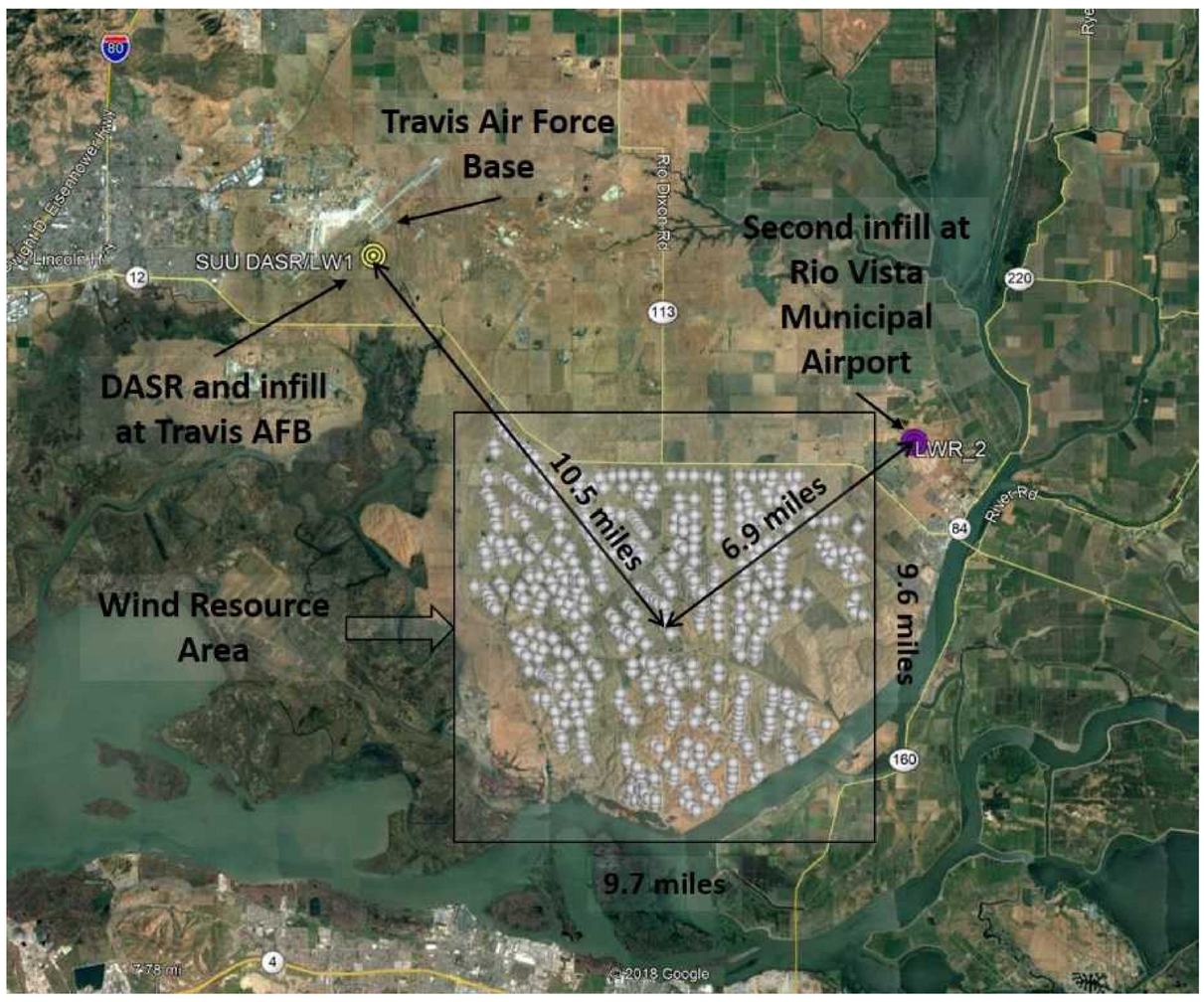


Spring pattern or parallel track



Petal pattern or sector search

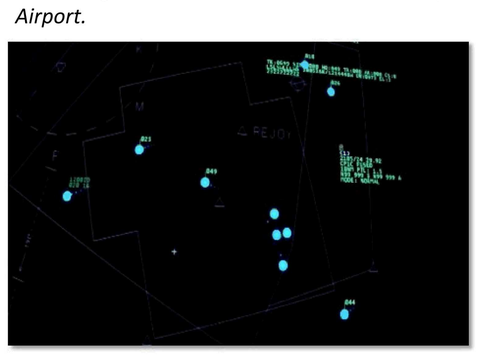
Spiral pattern or expanding square



Geographic overview of Travis Air Force Base in Solano County, CA. Shown are the locations of the Digital Air Surveillance Radar (DASR) and the two infill radars along with the Wind Resource Area (WRA). The wind turbines within the WRA are depicted with white dots, one per turbine.

Infill radar (left) next to the DASR tower and antenna on Travis AFB.

Second infill radar located at Rio Vista Municipal Airport.

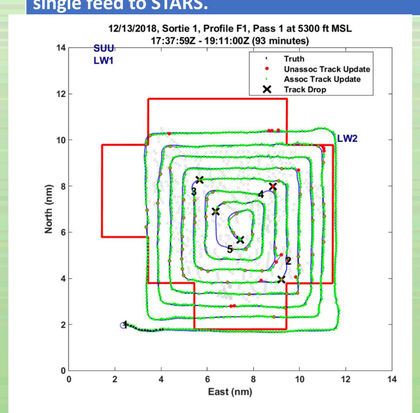


Screen capture of the STARS fusion display..

Radar Configurations Tested

Case	Description
1	DASR only inside WRA
2	DASR in the clear outside WRA
3	DASR with beacons + Infill1 + Infill2, inside WRA
4	DASR + Infill1 inside WRA
5	DASR + Infill2 inside WRA
6	DASR + Infill1 + Infill2 inside WRA
7	DASR + Infill-MS*
8	Infill-MS* only
9	Infill1 + Infill2
10	DASR + Infill1 + Infill2
11	DASR + Infill2

***LW-MS is a processing technique to provide radar plots based on a combination of returns from LW1 and LW2 as single feed to STARS.**



Track plot (green) with GPS truth (blue)

Air Traffic Controller Feedback

An air traffic control operator observed most of the CAP flights and provided comments about the air picture.

Comments on the ATC issues

- *Track breaks* mimic what an operator would see if a plane goes down.
- *Track duals* cause the operator to lose position information of the aircraft. These are particularly troublesome when the duals follow a real aircraft so the operator cannot distinguish the two tracks (real from fake) even with ATC directed aircraft maneuvers.
- *Track seductions* tell the operator the aircraft is far removed from its true location.

Next Steps: Infill Validation within FAA

Success of the PMP led to a validation effort led by the FAA in partnership with the Air Force

- Define processes and develop Concept of Operations, Requirements, and Test Plan

Use infill radars at Travis to beta test validation processes

- Goal: Demonstrate infill radars as a mitigation technology to wind turbine clutter

A step beyond the proof of concept from the PMP

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