AMS100

KS8.1: Assessing the Weather Observation Capabilities of a Spectrum Efficient National Surveillance Radar (SENSR)

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In 2016, the FAA, NOAA, Department of Defense (DoD) and Department of Homeland Security (DHS) initiated a feasibility study for a Spectrum Efficient National Surveillance Radar (SENSR). The goal is to assess approaches for vacating the 1.3 to 1.35 GHz radio frequency band currently allocated to FAA/DoD/DHS “Long Range Radars (LRR)”, so that this band could be auctioned for commercial use. One approach to accomplishing this is the use of phased array radar to consolidate the LRR mission with that of near-airport aircraft detection and tracking radars, and weather surveillance radars which operate in the 2.7 to 3.0 GHz band. The participating agencies have developed SENSR “Preliminary Performance Requirements (PPR)” to communicate consolidated technical requirements to the aerospace industry. These assume as a minimum the capabilities of legacy operational radars, with several significant enhancements. For example, volumetric scan rate goals for both weather and aircraft surveillance are higher than current operational radars, height-finding capability for aircraft is required, and sensitivity requirements are more stringent. The PPR facilitates objective evaluation of proposed approaches to achieving SENSR goals.

This paper will provide an overview of activities, goals and initial results from NOAA-led SENSR research assessing “high resolution weather surveillance” requirements and candidate technical approaches to meeting these. Research activities encompass measurements, analysis and modeling using scaled, active array radar testbeds, data driven simulators and storm observations. Key components of the effort are:

(i) Assessment of techniques to compensate for inherent polarimetric variable estimate errors using a planar phased array. This includes, but is not limited to, “geometric biases” as the array is steered off broadside, and characterization of likely residual errors after appropriate compensation techniques are applied;

(ii) Analysis of the unique challenges associated with a cylindrical polarimetric phased array radar (CPPAR). While CPPAR eliminates geometric biases of the polarimetric variables, it raises other issues such as possible surface “creeping wave” interference, challenges in achieving sufficiently low antenna sidelobes, and electronic scanning constraints that reduce the flexibility of volume scanning patterns;

(iii) Assessment of engineering issues and the operational benefits of an all-digital active array architecture. This may enable more effective array calibration and compensation techniques, and facilitate efficient scanning through the use of simultaneous receive beams steered at widely separated angles;

(iv) Simulation and analysis to assess strategies for managing the SENSR scanning timeline to satisfy the requirements of its multiple missions, while maintaining required performance in areas such as detection and parameter estimation, spatial resolution and rejection of interference or clutter;

(v) Analysis of operational benefits that may be realized through improved low-altitude weather coverage. This enhanced coverage would result from the availability of high-quality weather observations from multifunction radars replacing current air traffic surveillance radars;

(vi) Expanded and refined assessment of the forecasting and warning benefits of rapid-scan, polarimetric phased array radar observations. This assessment will exploit storm observations, observing system simulation experiments, radar-data assimilation experiments and human-in-the-loop studies.

The aim of this research is to refine and justify – in terms of National Weather Service mission benefit – final SENSR technical requirements. These requirements will be provided to industry in 2018 as a basis for procurement of one or more prototypes for follow-on testing, evaluation and refinement.

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