X-Band Phased Array Radar

Technical Specifications

Request for Information 956767

Battelle is contemplating the procurement of a portable X-band phased array radar (PAR) to support the ARM user facility in storm tracking and uncrewed aerial system (UAS) operations.

This radar must be easily re-deployable because it will be moved periodically among ARM observatory locations. Set-up time should be on the order of or less than a day to accommodate flexible siting requirements.

We have in mind several core requirements; however, we are aware that there are various design characteristics that impact PAR functionality and cost. Foremost among these are dual-polarization and the technology used for beam shaping. Through this request for information, we hope to gain a better understanding of available PAR systems and the impact of various design elements on system capabilities and cost.

The base physical requirements for the system we are seeking are as follows:

- X-band wavelength
- Measurements of reflected power and Doppler velocity
- An achievable effective beamwidth <= 2^o
- Pedestal that rotates 360 degrees azimuth with rate of at least 5 rpm
- Pedestal acceleration/deceleration on the order of 20 degrees /s^2
- Electronic scans +/- 45 degrees horizontal plane and +/- 15 degrees vertical plane
- Minimum sensitivity ~25 dBZ at a range of 30 km
- Internal calibration source
- Capable of operating in conditions with average wind speeds up to ~50 mph
- Capable of operating in ambient temperatures ranging from -50C to 50C

The radar must come with software to support flexible beam shaping, scanning, and communication with external line commands or software. Specific desired software functions include:

- Ability to shape the transmission beam for the minimization of beamwidth and side lobes and to code the transmission pulse
- Ability to execute standard weather scans: PPIs, RHIs, and sectors, with user defined parameters such as elevation angles and scan speeds
- Ability to track meteorological targets (e.g. developing convective cells)
- Ability and pre-packaged software for detecting and displaying location of multiple aircraft targets to support Beyond Visual Line of Sight operations of uncrewed aerial systems (drones)
- Ability to receive external commands (e.g., from an external software script) for control of any of the above parameters (e.g. beam shape, scan type, antenna pointing, etc)
- Output of radar reflectivity, Doppler velocity spectra, averaged Doppler velocity and Doppler spectrum width
- Automatic application of internal calibration checks

Additionally, we would like to understand the availability and cost of several specific design elements under consideration:

- Dual polarization
- Digital beamforming

We consider dual polarization and digital beamforming to be desirable, but have not committed to them as requirements. We are reserving judgment on this until we understand better the cost impact of these capabilities.

Through this request for information, we want to learn:

- What options exist that meet our basic requirements?
- Do the proposed PAR systems use analog beam-forming or are they fully digital? If there are options for both, what is the cost differential between these options?
- What is the additional cost to implement dual-polarization?
- Are there example data to demonstrate the quality of dual-polarization measurements?
- What range in sensitivity is possible and what is the associated cost?
- What range in azimuthal speed and acceleration are possible and what is associated cost? Is there a particular cost break point (the cost increases significantly for pedestals that exceed a certain speed and acceleration)?
- What software functionality is available for observing meteorological phenomena and tracking uncrewed aerial systems?
- What are available data outputs?
- What is the experience of prospective vendors delivering and supporting related systems?
- What is the expected delivery time?