SALIENT FEATURES OF THE RADAR NODES IN THE PUERTO RICO TROPICAL WEATHER TESTBED

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1. ABSTRACT

A tropical weather testbed will be constructed on the western coast of the island of Puerto Rico to study Quantitative Precipitation Estimation (QPE) in a tropical, orographically complex environment. This testbed is modeled after the CASA IP1 radar network [Junyent, F., et al.], also known as NetRad, a Distributed Collaborative Adaptive Sensing (DCAS) network. Like CASA's IP1 radar network, the Puerto Rico testbed will consist of a small cluster of low-power, short-range, dual polarized X-band Doppler radars, hereafter referred to as the Testbed nodes. The Testbed nodes will be deployed as to maximize the overall multi-radar coverage over the areas of interest, which will be determined taking into account both meteorological value, terrain characteristics, infrastructure availability, and social vulnerability inputs. The Testbed nodes shall consist of a transceiver, antenna, antenna positioner, data acquisition unit, signal processor, and the appropriate infrastructure to store and disseminate the radar data, while granting remote operation through automated control tools. The node transmitter will operate in the 9.41 GHz ± 30 MHz frequency range, using a magnetron-based transmitter with 25kW peak output power to be housed in a weatherized enclosure, along with the receiver and data acquisition unit, above the axis of rotation and near the center-fed parabolic antenna supporting dual polarization. The parabolic reflector will provide adequate resolution to detect tropical rain events, having an antenna gain in excess of 38 dB and a beamwidth of no more than 1.8 degrees. The antenna positioner will provide 360 degrees of rotation in azimuth and up to 90 degrees in elevation, and will be capable of performing arbitrary scanning patterns. Communication of radar signals and control commands between the radar transceiver and signal processor shall be via Gigabit Ethernet.

An important consideration in the design of the radar nodes is its geographical location in a tropical seaside environment on the island of Puerto Rico. Puerto Rico can experience severe tropical storms during the hurricane season, and therefore the radar node antenna and positioner must be able to operate in sustained winds up to 80 mph. Another design concern is the proximity of the radar nodes to the ocean, which has high humidity and elevated salinity in the air. These two effects, when combined, tend to accelerate corrosion of non-weatherized components, when compared to the NetRad radar nodes in Oklahoma. During summer months, the high temperatures can affect the operation of the radar node without proper climate control. All of these facts have to be factored in during the design phase of the radar node systems, providing adequate solutions to ensure the system's mechanical and electrical survivability and ability to operate continuously in a tropical environment.

This paper will present the design guidelines and relevant characteristics of the radar nodes of the Puerto Rico Tropical Weather Testbed, together with a description of the radar node system hardware and software architecture, and expected operation capabilities and data products. Special emphasis will be put on all the aspects that make the proposed radar node design capable of networked operation in a tropical environment.

2. REFERENCES

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