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Quantitative Precipitation Estimation with Distributed Radar Networks

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ABSTRACT

The Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) is working with Texas Medical Center to improve flood forecasting in small urban watersheds. CASA is developing a distributed network of short range radars having the potential to provide data at higher accuracy and finer spatial and temporal resolution than the rainfall data products currently being fed into distributed hydrologic models and flood alert systems. This talk describes our efforts to realize a network of small, low-cost X-band radars suitable for deployment in high-population urban regions. The radar design is based on a single- polarization Raymarine "boat radar" suitably modified to suppress clutter and deal with the vertical variation in rainfall intensity. The radars operate at short micro-wavelengths where rainfall-induced attenuation is significant and must be accounted for in the radar siting, power budget, and signal processing. We are investigating the use of network-based processing of single-polarization radar echoes to retrieve the intrinsic reflectivity of rain storms, from which rainfall products can be derived. The radars are supported by a small data acquisition and power system, such that each radar "node" weighs less than 100 lbs and occupies a total volume less than 1.5 m3. The radars can be controlled using an ad-hoc wireless network or ethernet connection, through a web based interface and display. The Texas Medical Center (TMC) is located in downtown Houston, Texas in a region that is highly susceptible to flooding. The forecasting and warning of impending floods is important to both the city of Houston and the medical center due to the dense population of the area, and the critical operations undertaken by the hospital when flood conditions are forecast. Presently, the medical center utilizes FAS2, a flood alert system developed by CASA partner Rice University that uses data from the WSR-88D "NEXRAD" radar network, along with rain gauges in the region, coupled with and hydrological modeling to forecast the likelihood of flooding. The installation of a new dense network of small radars, feeding advanced hydrological models based on Vflo software, and operating alongside the well-calibrated FAS2 system, provides a unique test-bed opportunity to assess the degree to which this new class of radar network can support the needs for improved flood forecasting in urban regions. This paper will present the system architecture of this new flood-alert concept as well as the early field trials from the first prototype radar installation atop a building rooftop at the Houston beginning in November 2006.

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