15B.2: Development of a Mobile C-band Polarimetric Atmospheric Imaging Radar (PAIR)

Tuesday, August 29, 2017
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Swissotel Chicago - St. Gallen

The University of Oklahoma (OU) has a long history of severe local storms research and field program activities using mobile radars, and has always pushed the limits of technology to further the science. In 2015, OU was awarded a large, five-year project by the National Science Foundation (NSF) to design, fabricate, and commission a next generation mobile polarimetric phased-array radar. Based largely on promising results already obtained by the Atmospheric Imaging Radar (AIR), and experience gained from the development of an all-digital polarimetric phased array radar in the Advanced Radar Research Center (ARRC), this new Polarimetric Atmospheric Imaging Radar (PAIR) will be capable of the high spatial resolution afforded by a mobile system, with unprecedented temporal resolution using an imaging technique. The PAIR will be a shared facility that has the potential to allow new and important discoveries by scientists from around the world about tornado genesis, and other severe weather phenomena such as lightning and hurricanes.
The concept, functionalities, and progress of PAIR will be reported in this presentation. Compared to AIR and other existing PAR systems, the new proposed system achieves dualpolarization through novel polarimetric phased-array antenna design; improved detection capability through integrated solutions provided by solid state power amplifier (SSPA) technology; faster update time through digital beamforming (DBF) in elevation and electronic scanning in azimuth; and a robust structure for fast deployment in severe environments. As a result, PAIR is capable of providing volumetric polarimetric measurements of 90o×20o with native a broadside beamwidth of 1.5o x 1.5o, and range resolution of 10 m in approximately 2.5 s. The C-band architecture of the PAIR provides significantly less attenuation than typical X-band mobile platforms, better aliasing velocities, and offers a differentiating tornadic debris estimate compared to most mobile platforms. PAIR represents a new paradigm for meteorological observations that will enable the exploration of new scientific frontiers related to severe storms such as tornadoes, hurricanes, numerical weather prediction and data assimilation, lightning, and will significantly advance polarimetric phased array technologies.
This paper focuses on the overall description of PAIR, design trade-offs, and predicted performance of the radar system. Specifically, preliminary results of the radar front-end subsystem will be discussed, such as the high performance radiating panel the preliminary performance of transmit and receive (T/R) modules designed in a tile configuration.

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