2022 IEEE Texas Symposium on Wireless and Microwave Circuits and Systems

Keynote Presentation

April 19th, 2022 10:15 – 11:00 AM

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The Horus Digital Phased Array Weather Radar

Sampling of existing mechanically scanning radars is insufficient to capture the four-dimensional evolution of atmospheric dynamics and microphysics. The scientific community has shown intense interest in the development of rapid-scanning polarimetric radars to address these needs and strongly desires community-wide access to the necessary phased array radar technology. To meet the desired update times and polarimetric quality, it is expected that a fully digital phased array architecture will be necessary. The Advanced Radar Research Center (ARRC) at the University of Oklahoma (OU) is working with NOAA's National Severe Storms Laboratory (NSSL) on the development of a digital-at-every-element, S-band, dual-pol phased array radar. The mobile radar is called "Horus" after the Egyptian god of war and sky. With an aperture of approximately 1.63 m, the Horus radar will have 1024 (32×32) dual-pol channels and will be capable of extreme flexibility in terms array segmentation, channel-independent waveforms, adaptive beamforming, etc. Each channel will produce more than 10W of peak power and will support a duty cycle of 10%, thus providing a sensitivity of approximately 12.5 dBZ at 50 km. Though its limited size means that the S-band Horus radar does not provide the angular resolution typically expected from a weather radar, it is extremely scalable and will serve as an engineering testbed for next-generation weather radars. Given the importance of radar polarimetry to the weather community, its most-important feature will be the capability of performing real-time and frequent array and polarimetric adaptive calibration as a routine part of the Horus scanning strategy. By exploiting mutual coupling between individual radiating elements that make up the array and the waveform independence of an all-digital array, the ARRC is currently developing automatic algorithms for array/polarimetric calibration. The need for an all-digital design will be discussed along with certain design choices of the Horus radar. Project status and plans for future larger-scale systems exploiting the scalable design of Horus will be provided.

Dr. Robert Palmer "Bob" has decades of experience as an academic thought leader. Currently, he holds the Tommy C. Craighead Chair in the School of Meteorology at OU and is an Associate Vice President for Research & Partnerships. He also established and is Executive Director of the nationally recognized Advanced Radar Research Center [http://arrc.ou.edu]. He received the Ph.D. degree in electrical engineering from the University of Oklahoma, Norman, in 1989. From 1989 to 1991, he was a JSPS Postdoctoral Fellow with the Radio Atmospheric Science Center, Kyoto University, Japan, where his major accomplishment was the development of novel interferometric radar techniques for studies of atmospheric turbulence. After his stay in Japan, Dr. Palmer was with the Physics and Astronomy Department of Clemson University, South Carolina. From 1993 to 2004, he was a faculty member in the Department of Electrical Engineering, University of Nebraska, where his interests broadened into areas including wireless communications, remote sensing, and pedagogy. While at OU, his research interests have focused on the application of advanced radar signal processing techniques to observations of severe weather, particularly related to phased-array radars and other innovative system designs. He has published widely in the area of radar remote sensing of the atmosphere, with over 110 peer-reviewed journal articles, a textbook, 40 international invited talks, and over 300 conference presentations. His research has an emphasis on generalized imaging problems, spatial filter design, and clutter mitigation using advanced array/signal processing techniques. He is a Fellow of both the American Meteorological Society and the IEEE and has been the recipient of several awards for both his teaching and research accomplishments.