Ongoing Development of an Ultra-Lightweight Digital Correlation Radiometer for L-Band Passive Remote Sensing from UAVs

Eric M. McIntyre, Albin J. Gasiewski
Dept of Electrical and Computer Engineering
Center for Environmental Technology
University of Colorado at Boulder

The lobe-differencing correlation radiometer (LDCR) is an ultra-lightweight L-band digital lobe-differencing correlation radiometer intended for airborne UAV sea surface salinity (SSS) mapping. Recent progress has been made in the development of the LDCR. The LDCR is comprised of two primary subsystems: an RF frontend and digital back-end. The lobe-differencing correlation technique uses simple printed GeCoCo antenna elements in a small 2 x 2 array to measure the brightness temperature difference between the ocean surface and cold space, thus providing accurate calibration. Differential correlation radiometry provides a precise and stable means of measuring the difference between two radiometric signals. The digital back-end processor is implemented on a field programmable gate array (FPGA) that and includes demonstrated techniques for anthropogenic interference mitigation, including time domain blanking, frequency domain subband filtering, and statistical kurtosis detection to ensure the accuracy of sea surface brightness data. The radiometric front end design implements a correlation radiometer and provides sum and difference channels of the zenith and nadir looking beams, which are sampled digitally. The calibration system is over-solved by the inclusion of a PIN diode switch and calibration terminator for each channel designed such that the sum and difference channels may be composed of (1) the nadir and zenith beams, (2) the nadir beam and a calibration terminator, (3) the zenith beam and a calibration terminator, or (4) two calibration terminators. The sum-difference channels are sampled at 200 MSPS by a 14-bit two-channel simultaneously sampling A/D. A Xilinx Virtex5 FPGA performs real-time preliminary data processing on each channel. The final two elements of the pipeline are computed on a host PC which collects and stores the data. Currently a prototype of the LDCR is under development. Initial deployment of the radiometric front end and backend is anticipated for Summer 2009.