RFI REMOVAL FROM 385 CHANNEL HYPERSPECTRAL L-BAND RADIOMETER MEASUREMENTS

Fredrick Solheim[(1)], Peter Toose [(2)], and Tom Watts[(3)]
(1) Radiometrics Corporation, www.Radiometrics.com
(2) Environment Canada, Toronto, Ontario Canada, (3) Northumbria University, Newcastle upon Tyne, UK

A downward looking airborne dual polarization L-band radiometer that captures the reserved astronomy band from 1400 to 1427 MHz and the band above to 1550 MHz was produced for the Meteorological Services Canada Twin Otter aircraft. The radiometer is part of an ensemble of downward looking dual polarization radiometers for observing the planetary surface that includes 19, 37, and 89 GHz. The primary function of this L-band system is to measure the dielectric properties of the earth's surface from the aircraft, and therefore infer soil moisture.

Because of the significant incursion of RFI in the lower frequency L-band and the difficulty in identifying contaminated data, especially as seen from an airborne platform, mitigation of anthropogenic emissions was requisite. To identify these intrusions, the IF power is fast sampled in 10 microsecond samples with a 2 gigasample/second 14 bit A2D converter and the samples passed through an FPGA-based fast Fourier transform into the frequency domain. This produces 385 channels of about 4 kHz in width.

To remove the RFI and recover the desired thermal spectrum, a relatively simple yet effective and accurate method was devised. The desired brightness temperature emitted by the earth is centered at the Gaussian distribution of the thermal noise. The NEDT of the radiometer system is related to the width at the half-power of the Gaussian distribution. Nongaussian anthropogenic emissions, if detected by the radiometer, add to the thermal noise but add only to the warmer side of the thermal Gaussian. Thus, the cooler side of the Gaussian from the peak to lower brightness temperatures contains only the desired thermal emission.

Sorting the calibrated channel brightnesses by magnitude allows separation of uncontaminated channels from those containing RFI. This sort is monotonically increasing and contains an inflection point at the center of the Gaussian distribution, below from which the desired thermal signal can be extracted.