A Wideband Spectrometer with Automatic RFI Detection

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We report on the design and construction of a wideband spectrometer of 500 MHz instantaneous bandwidth that includes automatic Radio Frequency Interference (RFI) detection. The implementation is based on the Center for Astronomical Signal Processing and Electronics Research (CASPER) iADC and iBOB boards. The iADC provides 1 gigasample/s 8-bit digitization, and the iBOB provides FPGA (Field Programmable Gate Array) resources for implementing a 1024-channel digitial spectrometer. The unique aspect of the spectrometer is that it accumulates both power and power-squared statistics which are then used to develop a "spectral kurtosis" (SK) estimator as described by Nita et al. (2007, PASP 119, 805).

The SK estimator is used offline for real-time detection and excision of RFI embedded in the received signal. The required power and power-squared data are broadcast by the FPGA via fast ethernet and converted to the SK estimator using software implemented in LabVIEW. The LabVIEW software then applies a mask based on the SK estimator to eliminate times and frequencies contaminated with RFI, thus recording a clean power spectrum in real time.

We report on the use of this spectrometer in an instrument being developed at the Owens Valley Solar Array, called the Korean Solar Radio Burst Locator (KSRBL). This instrument utilizes four of these 500 MHz bandwidth SK spectrometers in parallel, to achieve a 2 GHz instantaneous bandwidth that is time multiplexed over the entire DC-18 GHz radio frequency range, to study solar bursts. The performance of the spectrometers for excising RFI over this range is presented. The SK algorithm can also be applied to spectral channels of an FX correlator, either pre- or post-correlation, to remove unwanted RFI from interferometer data.

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