The Starburst Correlator: A Versatile Digital Back-end for Wideband Interferometry
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The Starburst program is an experiment to perform wideband dynamic spectroscopy of stellar radio bursts using a dedicated backend on two 27-m dishes at the Owens Valley Radio Observatory. Starburst aims to make the first detections of stellar coronal mass ejections (CMEs) to illuminate the space weather conditions for planets outside our solar system. Detecting and identifying the radio burst produced by a stellar CME requires sensitive polarized spectral observations with fractional bandwidth greater than 1 and high time cadence.

We present a versatile analog and digital backend designed for the Starburst program. 5 GHz of instantaneous bandwidth, tunable to 4 bands in the 1-18 GHz range, is downconverted to I/Q baseband using low-cost commercial RF components. The signal is then digitized and processed in a Virtex 6 FPGA, using a CASPER ROACH2 board. Dual 8192-channel Polyphase Filterbanks channelize the spectrum. Off-line calibration provides coefficients used in digital sideband-separation. Coarse delay correction can be performed in the time-domain, while sub-sample correction is applied by quadratic-interpolated coefficients, which can be updated every second, if desired. Both power and the fourth moment (used in the calculation of kurtosis) are computed on-chip. Up to four ROACH2 boards can be connected through 8x 10GbE links to perform cross-correlation of their respective 5 GHz spectra. The correlator supports integration times of 7 ms to greater than 1 second. The entire design is to be open-source and should be useful for many wideband radioastronomy and earth-observing-science applications. This talk will discuss the design of the analog and digital systems, calibration techniques, sideband-separation and other considerations for using this design in novel systems.