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FPGA-based Focal Plane Array Beamformer Architectures for the Expanded GMRT

Sunday, 15 September 2019 17:15 (15 minutes)

The Expanded GMRT (eGMRT) is a proposal to look at three expansions to the GMRT - increasing the field of view, increasing angular resolution and improving the sensitivity to the extended radio emission. In this talk, we would focus on increasing the field-of-view using Focal Plane Array (FPA) and the ongoing development of the FPGA-based prototype FPA beamformer. A prototype is being developed to understand the challenges in building real-time beamformer with multiple inputs and multiple beams. As part of this project, we have calculated the computational complexity of implementing FPA beamformer in real-time and the various tradeoffs at the architectural level. This tradeoff analysis helped in arriving at an optimal number of inputs, spectral channels, and beams for Virtex-5 FPGA. In case of an FPA system, the computation of beamformer weights through the correlation operation is only needed at distinct time intervals. This led to a further increase in the number of inputs for the same hardware setup, by separating the correlation and beamforming designs, and exploring FPGA reconfigurability. An alternate approach through a fully offline correlation design using recorded raw voltages would also be described. The current version of the multi-element, multi-beam design of the narrowband (32 MHz bandwidth, 16-input, 4-beam) and wideband (300 MHz bandwidth) beamformers have been developed using the CASPER (Collaboration for Astronomy Signal Processing and Electronics Research) methodology. The recent test results from the above- mentioned beamformer designs conducted in a free-space test range (at the GMRT site) would be described. As a step towards migration to contemporary signal processing platforms and the final prototype beamformer, we have started beamformer development using Xilinx RFSoC (RF System-on-Chip).