

Development of IA Beamformer using Packetized FX Correlator

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ABSTRACT

The incoherent beamforming technique helps in observing a known pulsar with higher sensitivity to get the pulsar profile. As part of the GMRT backend upgradation system, an incoherent beamformer is implemented on FPGA platform. The goal of the project is set to design the incoherent Packetized Beamformer for R circular and L circular polarizations of 4 antennas on FPGA platform. The Packetized Beamformer will be the first beamformer of its kind to be working at a bandwidth of 400 MHz on the ROACH boards. The design approach was to use the packetized correlator design of F-X engine for 4 antenna and then implement a 4 antenna input incoherent Packetized Beamformer as an add-on to it. The designing part includes developing and implementing beamforming logic and designing the Packetization and Depacketization of the 10GbE packet. The individual logics were tested and verified using the simulation results. Finally the 8 input, i.e., R and L polarizations of 4 antennas, incoherent Packetized Beamformer is implemented on multiple FPGA boards. The report briefly describes Depacketization and offline data processing. The testing of the design is done with noise source and real time radio source like Pulsars. Results of sky tests performed with the Packetized Beamformer are also provided suggesting the beamformer is functional.

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LIST OF ABBREVIATIONS

GMRT = Giant Metrewave Radio Telescope

FPGA = Field Programmable Gate Array

FFT = Fast Fourier Transform

PA = Phased Array

IA = Incoherent Array

GSB = GMRT Software Backend

ROACH = Reconfigurable Open Architecture Computing Hardware

ADC = Analog to Digital Converter

R = Right circular polarization

L = Left circular polarization

PFB= Polyphase Filter Bank

MAC = Multiplier and Accumulator

10GbE = 10 Gigabyte Ethernet

LUT = look Up Table

PMON = Pulsar Monitoring Software

FIFO = First Input First Output

RF= Radio Frequency