

REAL TIME IMAGING

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In this paper, we propose to integrate calibration and imaging with DSP hardware in order to handle high data rates and make images in close to real time with radio telescope arrays, such as the SKA and ATA, with large numbers of antennas and large fields of view. We propose to use modular DSP boards with a flexible interconnect architecture which allows reconfiguration of computing resources for multiple projects. Correlators and beam formers with a high data bandwidth into computer clusters support a flexible programming environment. The system design allows radio astronomy to implement the latest technology in a cost effective and timely manner. The correlation function is computed with narrow frequency channels and short integration times so that images can be formed over a large field of view. Images can be made simultaneously in multiple regions within the field of view by integrating the output from the correlators at multiple phase centers on targets of interest, calibration sources, and sources whose sidelobes will confuse the regions of interest. The calibration can be improved by using a global model of the sky brightness and gains. RFI and time variable sources must be identified and measured so they can be correctly separated and subtracted from the data. The calibration varies across the sky due to frequency and time variations in the primary beam, instrumental polarization and non-isoplanicity. We must measure the gain variations in the directions of sources whose sidelobes corrupt the regions of interest. Calibration is made in close to real time using the model of the sky brightness distribution. The derived calibration parameters are fed back into the imagers and beam formers. Images are made simultaneously for multiple phase centers using an FFT algorithm in restricted fields of view. Sidelobes from sources outside each of the regions imaged are minimized by subtracting the model from the data before imaging. The regions imaged are used to update and improve the a-priori model, which becomes the final calibrated image by the time the observations are complete.

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