URSI - RCRS 2022, IIT (Indore), India, 1 - 4 December, 2022

IIT Indore Radio Interferometer (IIRI)

Ankit Bhanu[(1)], Archishman Guha [(1)], Harsha Avinash Tanti[(1)], Abhijeet Datta[(1)], Narendranath Patra[(1)], Abhirup Datta[(1)] and Siddharth Malu[(1)]
(1) Indian Institute of Technology Indore, Madhya Pradesh, 453552, e-mail: mt2102121001@iiti.ac.in

The observation and study of celestial bodies at radio frequency is known as Radio Astronomy. Astronomers use large radio telescopes for detection of Radio waves from astronomical sources. Technique used to obtain the resolution of a larger telescope using several smaller telescopes is known as Interferometry. To obtain a resolution of respectable resolution for radio wavelength observation, a single telescope of a few hundred kilometers will be required [2]. However, Radio Interferometry allows us to achieve these resolutions with a few meters of baseline, i.e., the largest distance between elements of the interferometer. Therefore, Interferometry provides a better solution for high resolution observations [3]. Very Large Array (VLA) in New Mexico U.S.A, G.M.R.T. in Pune India, LOFAR in Europe etc, are some examples of Radio Interferometers across the world.

The IIT Indore Radio Interferometer (IIRI) is a four-element antenna system currently operating at 1.4 GHz. It consists of four 4.5-meter dishes with maximum and minimum baselines of 73 and 50 meters, respectively [1]. It is the first of its kind and the only radio observatory to be installed on any IIT campus aiming for research and educational purposes. The solid dishes of IIRI have the capability to perform observations at higher frequency bands, e.g., C (4-8 GHz) and X band (8-12 GHz). The process of installing a C-band system is underway, which places this observatory uniquely as no observatory in India observes at these frequencies. For the 1.4 GHz system, IIRI uses a heterodyne receiver system along with an analog front-end [4]. The data are digitized, channelized, and recorded employing a digital backend built on FPGA [5]. I will discuss some of the niche features of IIRI and detailed characterization of its L-band sub-systems, including the digital backend, in this presentation.

1. S. J. Wijnholds, S. van der Tol, R. Nijboer and A. -J. van der Veen, “Calibration challenges for future radio telescopes,” *IEEE Signal Processing Magazine*, **27**, 1, January 2010, pp. 30-42, doi:10.1109/MSP.2009.934853.

2. M. Ryle, "A new radio interferometer and its application to the observation of weak stars", *Proc. Royal Soc. A*, **211**, 1106, March 1952, pp. 351-375, doi:10.1098/rspa.1952.0047.

3. R. Levanda and A. Leshem, "Synthetic aperture radio telescopes," *IEEE Signal Processing Magazine*, **27**, 1, January 2010, pp. 14-29, doi: 10.1109/MSP.2009.934719.

4. A. . -J. Boonstra and A. . -J. van der Veen, "Gain calibration methods for radio telescope arrays," *IEEE Transactions on Signal Processing*, **51**, 1, January 2003,pp. 25-38, doi: 10.1109/TSP.2002.806588.

5. S. van der Tol, B. D. Jeffs and A. -J. van der Veen, "Self-Calibration for the LOFAR Radio Astronomical Array," *IEEE Transactions on Signal Processing,* **55,** 9, September 2007, pp. 4497-4510, doi: 10.1109/TSP.2007.896243