LOW-FREQUENCY WIDE-FIELD IMAGING: FROM THE VLA TO THE LWA

Lazio, T. J. W.[1], Kassim, N. E.[1], Cohen, A. S.[1]
, Cotton, W. D.[2], Lane, W. M.[1], Perley, R. A.[2] , Condon, J. J.[2]
[1]Naval Research Laboratory
[2]National Radio Astronomy Observatory

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: lazio2015

Date Received: September 17, 2005

At frequencies below 1000 MHz, the increasingly larger fields of view of radio telescopes make two effects increasingly important. First, if an interferometer is non-coplanar (as most current and future instruments are or will be) its geometry introduces phase errors and image distortions at larger radial distances from the phase center. Second, the isoplanatic patch from ionospheric phase distortions can become smaller (potentially much smaller) than the field of view, leading to defocussing throughout the field of view.

There are now a series of methods to deal with the non-coplanar nature of interferometers, most notably polyhedral imaging and the w-projection. The former tessellates the field of view into smaller areas over which the interferometer can be assumed to be coplanar; the latter projects, via a Fresnel-like kernel, the three-dimensional sampling of the interferometer onto a two-dimensional plane, which is then inverted. Imaging in the presence of ionospheric phase errors has been accomplished generally by restricting the field of view to be smaller than an isoplanatic patch or by restricting the size of the array so that the number of isoplanatic patches within the field of view is not too large. We illustrate these approaches using examples from the 74 MHz system on the Very Large Array (VLA) (maximum baseline $\approx$ 35 km) and from the 74 MHz “Pietown-link” extension to the VLA (maximum baseline $\approx$ 70 km).

The Long Wavelength Array (LWA) is an interferometer being developed for operation at frequencies of 20–80 MHz, with maximum baselines approaching 400 km. While many of the existing methods will be suitable for observing programs with the early stages of the LWA, full exploitation of its potential will require development of new wide-field imaging methods. Development of new ionospheric calibration techniques may require revisiting traditional assumptions about the configuration of interferometers.

Basic research in radio astronomy at the Naval Research Laboratory is supported by the Office of Naval Research. The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc.

1. (a)
Joseph Lazio
Naval Research Laboratory
4555 Overlook Ave. SW
Washington, DC
20375-5351 United States
Joseph.Lazio@nrl.navy.
(b) 202 404-6329
(c) 202 404-6329
2. J - Radio Astronomy
3. (a) S-J3
4. I - Invited Paper, Program chair: Steven Myers
5. No special instructions