IONOSPHERIC CALIBRATION ISSUES FACING LOW FREQUENCY ARRAYS

Montgomery, M. H.[1,2], Bust, G.[2], Garner, T.[2], Gaussiran, T.[2]
[1]Department of Astronomy, University of Texas, Austin, TX 78712
[2]Applied Research Laboratories, University of Texas, Austin, TX 78713

Given that the magnitudes of the phase shifts introduced by the free electrons in the Earth's ionosphere vary inversely with frequency, i.e., $\Delta\phi \propto f^{-1}$, it is not surprising that the ionosphere is the dominant source of such errors at low frequencies. In addition, the field of view seen by each "station" will be larger at lower frequencies, so that there can be many "isoplanatic patches" across the field of view. Thus, instead of there being just one phase shift for each station, a position-dependent phase screen for each station will be required. For arrays with long baselines (~ 400 km), these phase screens will essentially be independent of one another, meaning that there will be many free parameters per station which will need to be determined. The calibration issues associated with this situation are the most significant difficulties facing the proposed low frequency arrays, such as the LWA, GMRT, EVLA, LOFAR, and SKA.

In this talk we examine the level of calibration which will be necessary for the Long Wavelength Array (LWA) to reach its stated goals of precision. For this purpose, we use existing 74 MHz VLA data to derive an estimate for the phase screen which would be seen by each of the LWA stations (each station will consist of an array of ~ 256 antennas), and we parameterize the result in terms of Zernike polynomials. In particular, we assess the number of Zernike polynomials which are needed in order for each station to reach a given accuracy in pointing, which in turn tells us about the number of free parameters per station which will be required for calibration.

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1. (a)
   Michael Montgomery
   Department of Astronomy
   University of Texas
   Austin, TX
   78712 USA
   mikemon@astro.as.utexa
   (b) (512) 471-3451
   (c) (512) 471-6016

2. J - Radio Astronomy

3. (a)

4. I - Invited Paper, Program chair: Steven Myers

5. No special instructions