All-Sky Imaging Search for Transients with the Long Wavelength Demonstrator Array

Tracy E. Clarke*[1], Wendy Lane[2], T. Joseph Lazio[2], Carl Gross[2], Paul S. Ray[3], Dan Wood[4], and Johnathan York[5]

[1] Naval Research Laboratory, Code 7213, Washington, DC & Interferometrics Inc., Herndon, VA
[2] Naval Research Laboratory, Code 7213, Washington, DC
[3] Naval Research Laboratory, Code 7655, Washington, DC
[4] Praxis, Inc., Alexandria, VA
[5] Applied Research Laboratories, The University of Texas at Austin, Austin, TX

The Long Wavelength Demonstrator Array (LWDA) is a prototype low frequency array located near the NRAO Very Large Array on the Plains of San Agustin in New Mexico. It is designed to operate between 60-80 MHz with an instantaneous bandwidth of 1.6 MHz. The 16 element LWDA consists of active dipole antennas, analog gain stages, flexible FPGA-based digital receivers and a digital beamformer. The digital receiver and data acquisition system allow cross correlation of each of the 120 pairs of antennas in the array to produce low-resolution images of the sky. The antennas receive dual orthogonal linear polarizations and the electronics are capable of digital delay beamforming with two fully-independent beams, as well as all-sky monitoring. The data are recorded in spectral line mode to allow characterization and excision of radio frequency interference. In late October, 2006 the LWDA hardware installation was completed, and successfully achieved first light. Since that time, the LWDA site has been in active use as a platform for hardware development and testing, as well as software development for control of the array and data handling. The operational system is currently engaged in scientific observations including all-sky surveying for sources of bright continuum transient radio emission, as well as targeted observations of pulsars. The LWDA has observed several solar bursts and should also be sensitive to giant pulses from the Crab pulsar.

We describe the initial transient detection pipeline that has been developed for the LWDA and present results from analysis of the first year of all-sky monitoring data. The initial data were taken in snapshots of 50 ms, at a frequency of 74 MHz, roughly every 5 minutes. Bright sources such as Cygnus A, Cassiopeia A, the Galactic Plane, and the Sun are clearly visible, but cannot be accurately modeled given the irregular celestial time sampling and variations in sensitivity across the primary beam. As a result, these sources were masked for the transient search. Additionally, due to an instrumental glitch, it was necessary to flag all high amplitude data with phase close to zero degrees; thus we are not sensitive to transients directly overhead or near the masked sources. We reach a sensitivity of about 400 Jy/bm over the remaining portions of the sky. In the future, more regular celestial time sampling will allow us to build up a standard "Sky model" which varies with time over the course of the day; by comparing new data to this standard we will be able to search for transients over the whole sky.