

NEAR-FIELD HOLOGRAPHY TECHNIQUES FOR LARGE RADIO ANTENNAS

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The ever increasing operating frequencies of radio antennas have approached the Tera Hertz bands, placing stringent demands on antenna performance and characterization. Near-field radio holography is the method of choice for characterizing the optics of large millimeter/sub-millimeter/THz wavelength antennas. In this presentation, near-field techniques to measure and align the components of such antenna systems will be reviewed. In particular, studying and setting the figures of the primary reflectors of sub-millimeter wavelength antennas will be discussed. Experience with the antennas of the 8 element Submillimeter Array, some of which have been set to an rms surface accuracy of 12 micron, will be used to illustrate the techniques. High signal to noise ratios are easily achieved in near-field measurements leading to maps of the aperture phase at high spatial resolution. This allows measurement and correction of flexures of individual panels of primary reflectors. The aperture amplitude maps measure the illumination achieved and can be used to validate the feed and beam wave-guide systems often used. The main limitation of the technique is the low elevations typical of such measurements. It is necessary have a good understanding of the gravitational deformation of the antennas in order to achieve good performance at operational elevations. Holographic measurements on astronomical sources can provide the complimentary information needed in addition to models of the deformations. Astronomical measurements typically have poorer signal to noise due the weakness of the radiation sources and high spatial resolutions are difficult to achieve. However, gravitational deformations occur on large spatial scales. Therefore, a combination of near-field and astronomical holographic measurements can completely characterize the primary reflector of an antenna system. Near-field techniques are also being used to align componenets of beam-waveguide systems and the current status of such measurements will also be discussed.

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