MEASUREMENT OF THE NOISE ASSOCIATED WITH THE SUBREFLECTOR SUPPORTING STRUTS OF A 34-METER CASSEGRAIN ANTENNA

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The scattered field produced by the subreflector supporting struts of a Cassegrain antenna can provide a potentially significant thermal noise pickup mechanism. In the continuous quest for lower-noise radio telescopes, a clear understanding of this noise contribution is then necessary. On a well designed system this noise source can be expected to be small, and hence its measurement is technically challenging. Indirect measurements of this noise contribution have been performed in the past (e.g., P. Potter, TDA Progress Report 32–1526, JPL, 22–29, 1972 and T. Otoshi, P. Lee, and M. Franco, TDA Progress Report 42–105, JPL, 160–180, 1991), but tend to include, together with the strut noise contribution, the effects of other difficult-to-characterize noise factors (e.g, panel gap leakage, perforated panel transparency, etc.). A direct measurement of the strut noise pickup is then desirable, and for maximum accuracy one would like to perform a differential measurement, with and without the struts present. Unfortunately this is a physical impossibility due to the lack of subreflector support in the latter situation.

Theoretical work on the scattering characteristics of supporting struts indicate that, typically, the back-scattered power density levels of a flat-face strut can be substantially reduced by properly shaping the strut cross section (F. Moreira, A. Prata, Jr., and M. Thorburn, IEEE Trans. Antennas and Propagat., 44, 492–499, 1996). This fact provides an alternative to perform a quasi-differential strut noise pickup measurement, and was exploited in the present work.

The noise temperature of the 34-meter diameter Cassegrain antenna of the Jet Propulsion Laboratory Deep Space Station 13 (D. Bathker, W. Veruttipong, T. Otoshi, and P. Cramer, Jr., IEEE Trans. Microwave Theory and Tech., 40, 1274–1285, 1992) was measured with and without shaped aluminum covers attached to the top strut of its inverted-Y subreflector supporting tripod. The shaped covers provide about 20 dB back-scattering reduction and virtually eliminate the strut-noise pickup associated with the top strut. The measurements, performed at both 8.425 and 2.295 GHz, indicate that about 0.2 K noise pickup is associated with the top strut when the antenna is pointing towards zenith, and that this number increases to more than 1.0 K for elevations below 15 degrees.

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