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REDUCING THE CONTRIBUTION OF INVERTED-Y SUPPORTING TRIPODS TO THE NOISE TEMPERATURE OF RADIO TELESCOPES

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Depending on the geometry, the struts used to support subreflectors (or feeds, in single reflector systems) of radio telescopes can pick up a significant amount of thermal noise from the ground surrounding the antenna. Invoking the reciprocity principle to analyze the radio telescope as a transmitting antenna it can be established that, for large physical apertures operating at moderate elevation angles, the dominant strut-related ground-noise contribution is produced when the collimated wave leaving the antenna scatters on the strut. Furthermore, this dominant contribution comes primarily from the struts attached to the collimating-reflector upper half. Due to this fact, an inverted-Y supporting tripod geometry generally has less noise contribution than other commonly used alternatives. In this work the inverted-Y tripod is then considered and optimized to reduce its associated noise pickup.

In order to determine the ground-noise pickup of the inverted-Y configuration, a numerical analysis has been carried out assuming that the radio telescope operates transmitting energy. In this situation a near-plane wave illuminates the struts, and the corresponding scattered electromagnetic field has been determined with high accuracy using integral equation techniques. Also, advantage has been taken of the fact that, on electrically large apertures, the struts have an electrically large length and hence can be modeled as infinitely long. The obtained strut-scattering characteristics have then been used to calculate the strut relative noise temperature contribution, as a function of the antenna elevation angle. With this information the top-strut cross-section has been optimized to yield minimum ground-noise pickup.

The results obtained indicate that minimum strut-related ground-noise pickup is achieved with struts that have a sharp edge directed towards the collimating reflector. In particular, an optimum closed-form tear-drop cross section was derived for the inverted-Y top strut. As a final conclusion it has been determined that, depending on the radio telescope existing supports, retrofitting the strut cross section may yield a five times reduction of the strut-related noise-temperature.

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