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26 November 1990

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Holographers

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Subject: Corrections to improve the accuracy of the radome diffraction model

1] Induced field ratio (IFR) correction

The radome spans are only a few wavelengths across and consequently the Fresnel integral requires some correction. The corrections result from currents that flow in the spars. For circular polarization and a wavelength of 1 inch, the 3″ x 5″ spars will have an IFR (see Rusch, et al, IEEE Ant. Prop. AP.24, No.2, pp.182, 1976) of 1.15 (with small phase shift) corresponding to a cross-section which is 15% greater than the geometric cross section.

2] The Scott/Ryle correction

When the antenna is scanned in the x direction through an angle Θ the path length d increase from an element at (x,y) on the antenna surface is

$$d = x\Theta + (a + (x^2+y^2)/4f)\Theta^2/2 \qquad (\textit{good to order } \Theta^2)$$

where a = distance from vertex to axis
f = focal length

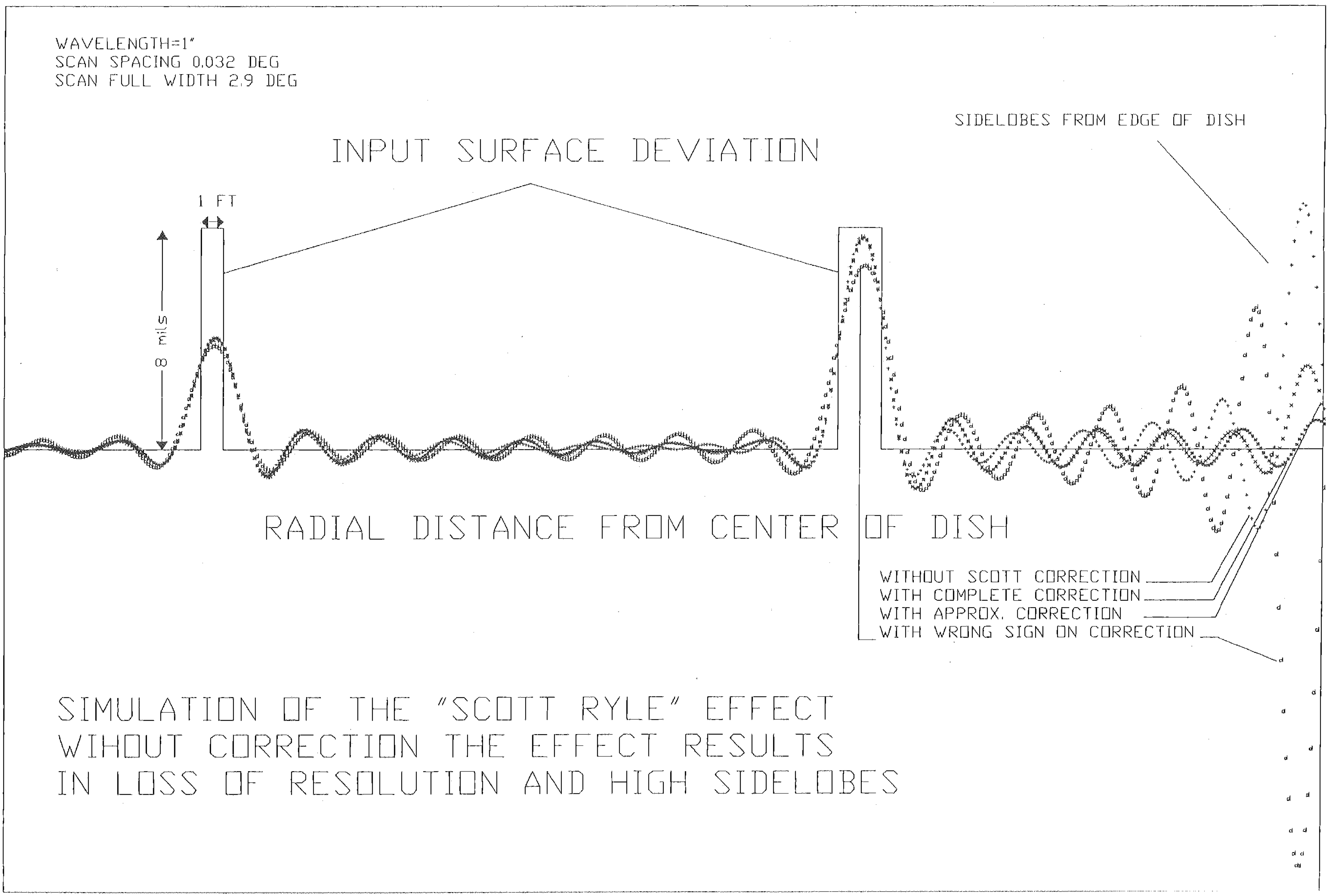
For high accuracy holography this should be taken into account in making the transform to surface deviations by using a descrete transform with phase term $2\pi d/\lambda$. In practice an FFT is used and only an average path length correction of

$$(a + r/4f)\Theta^2/2$$

is made where r = mean radius in aperture plane. I call this term the Scott Ryle correction. For the diffraction pattern, which is fixed to the radome the path length increase is

$$dd = x\Theta - (a + (x^2+y^2)/4f)\Theta^2/2$$

to order Θ^2. Thus applying the Scott Ryle correction with the correct sign will sharpen the picture of the antenna surface and blur the radome diffraction. Applying the Scott Ryle correction with the opposite sign will sharpen the radome and blur the antenna. For computing the diffraction model I have undone the Scott Ryle correction (for which Brian assumed $(a + (x^2+y^2)/4f) = 23.5'$) and applied diffraction correction to make the radome appropriately blurred to match the holography data. The attached figure shows the effects of the Scott Ryle correction in a simulation hologram.



SIMULATION OF THE "SCOTT RYLE" EFFECT
WIHOUT CORRECTION THE EFFECT RESULTS
IN LOSS OF RESOLUTION AND HIGH SIDELOBES