Field of View Analysis of SeaWinds Reflector Antenna

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Introduction: Antennas are often mounted among many other instruments on the spacecraft (S/C) platform. The electromagnetic interference (EM I) and compatibility (EMC) issues are of great concern to the antenna and S/C system design engineers, Considering the rotating reflector antenna of the NASA SeaWinds Scatterometer on the Japanese ADEOS II S/C, as depicted in Figure 1, it is desirable to determine the antenna's field of view (FOV) performance. In other words, how far should the other boxes be kept away from the reflector antenna to minimize the blockage/diffraction effects on the antenna's performance requirements (see 'I'able 1). Since the antenna is rotating around an axis parallel to the z-axis, the problem may now be interpreted as determining a limiting FOV cone angle such that no boxes should be placed inside. One could find the solution to this FOV problem by experimenting with a scale model of Figure 1. I Iowever, it is quicker and more cost effective to develop a numerical approach. Therefore, the high frequency technique of shooting and bouncing rays [1] will be applied, as described in this paper, to determine this antenna's FOV cone angle.

Analysis and Results: The DEMACO Apatch computer code was used in analyzing the antenna's performance in the complex S/C environment of Figure 1. Apatch is a high frequency approximation code for computing the radiation pattern of antennas mounted on scattering platforms. The reflector antenna and the various boxes were rendered in CAD facet models first. Then the Apatch code was used to compute the radiation pattern, gain, and beam-width by its shooting/bouncing ray implementation of the physical theory of diffraction [1]. The reflector antenna generates two beams (one on-focus beam and onc off-focus beam). The computed antenna performance for these two beams is summarized in Tables 2 and 3 as the antenna is spinning around the various boxes. Figure 2 shows a representative antenna radiation pattern.

Conclusion: Based on the extensive numerical results obtained from this study, wc concluded that the boxes should be kept 5° outside the rotating antenna's projected aperture in order to meet the gain and beam-width stability requirement stated in Table 1. It should be pointed out that this numerical approach is a versatile technique which can be applied to other complicated FOV or scattering problems.

References:

1. II. Ling, R. Chou and S.W. Lcc, "Shooting and bouncing rays: calculating the RCS of an arbitrarily shaped cavity," IEEE Trans., vol. AP-37, no.2, Feb. 1989, pp. 194-205.

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Table 1. SeaWinds Reflector Antenna Requirements

Parameter	Nominal	Accuracy	Stability
Gain (dB)	39	0.35	).2
Frequency	13.4 GHz		
Aperture Size	1.1 m diameter		
Mechanical Boresight	47 deg.		
Pointing Angle	Inner Beam, 47° Outer Beam, 41°	0.2°	
Polarization	Inner Beam, H pol Outer Beam, V pol		
Beam Width (deg.)	1.5 EL 1.7 AZ	0.1	1.04
Sidelobe Level	-15 dB peak, -30 dB for 10°<0<200,-40 dB for Θ> 20°		
Crosspol. Level	-20 dB		

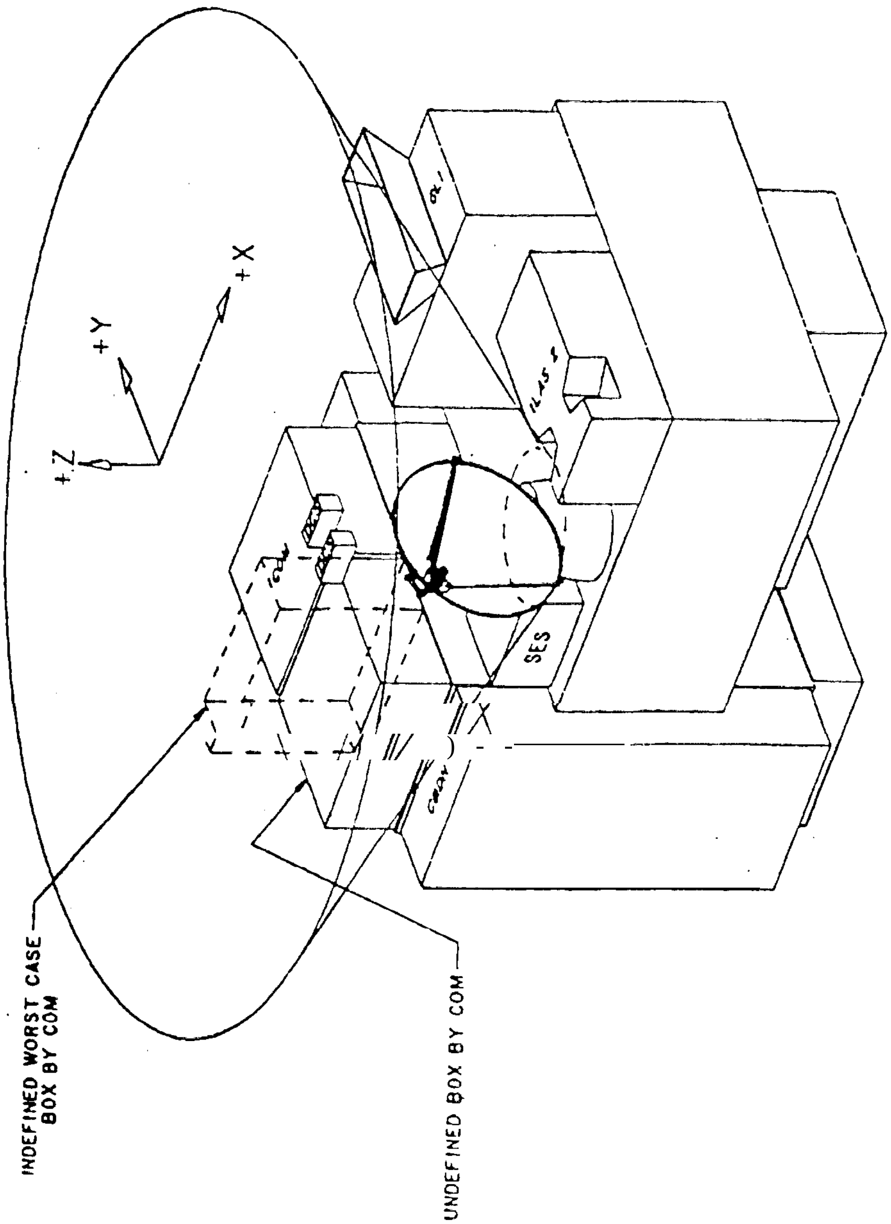
Table 2. SeaWinds **Reflector Antenna Field of View Study Summary**
On-Focus Beam

Scenario	Directivity (dB)	Half Power Beam Width (degree)		Highest Sidelobe Level (dB down from beam peak)
		Vertical	Horizontal	
Reflector Alone	41.58	1.55	1.73	23.6
GLI View	41.57	1.55	1.73	23.6
COM View	41.58	1.55	1,73	23.6
Worst Case	41.38	1.62	1.71	21.9

Table 3. **SeaWinds Reflector Antenna Field of** View Study Summary
Off-Focus Beam

Scenario .	Directivity (dB)	Half Power Beam Width (Degree)		Highest Sidelobe Level (dB down from beam peak)
		Vertical	Horizontal	
Reflector Alone	39.82	1.42	1.58	18.13
GLI View	39.81	1.42	1.58	17.98
COM View	39.82.	1.42	1.58	18.07
Worst Case	39.77	1.43	1.57	17.83

Figure 1. Configuration of SeaWinds antenna on ADEOS II Spacecraft.



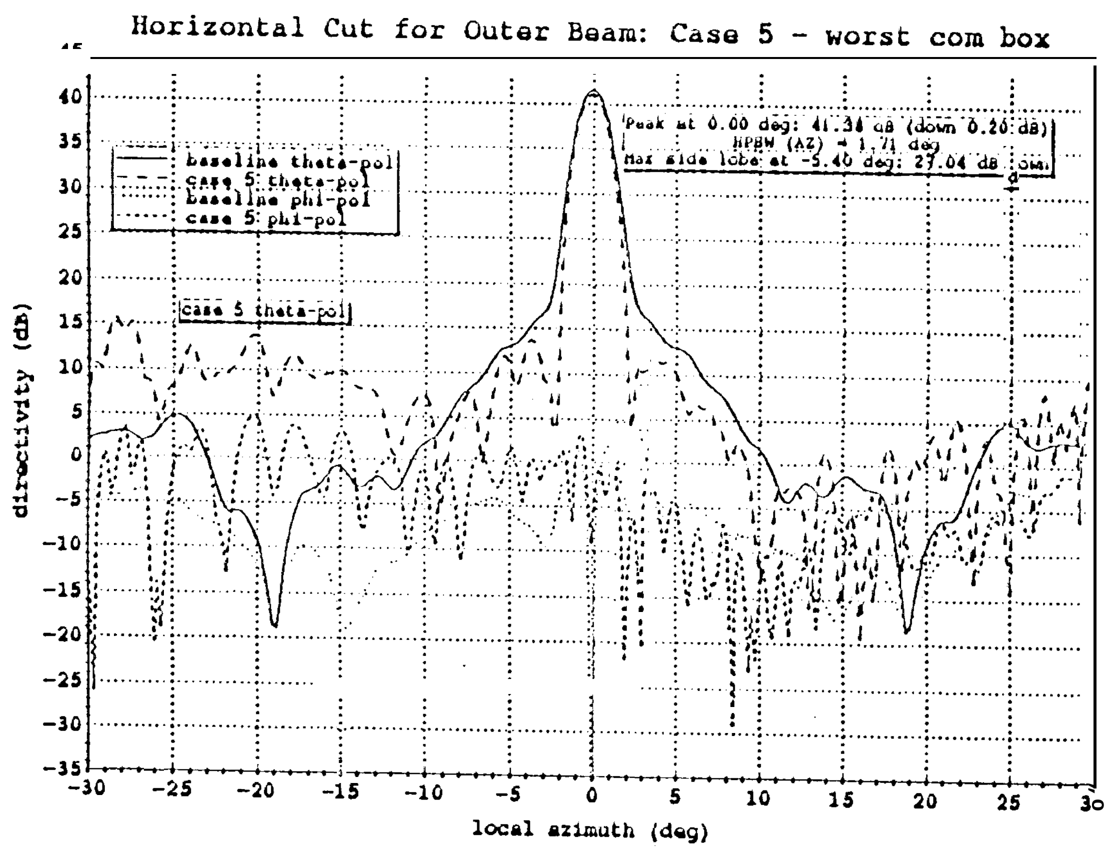


Figure 2. Representative SeaWinds reflector antenna radiation pattern.