dure based on the success of geometric correction with other airborne sensors [4].

To evaluate the gross geometric fidelity of the raw data product, four narrow swath scenes in ground range presentation that contained Lac Deschênes, near Ottawa, were studied. Each ~16 x 16 km scene contained about 15 evenly distributed Ground Control Points (GCP's) at road intersections measured in a UTM (Universal Transverse Mercator) coordinate system. The terrain height variation over the whole scene measured was less than 50 m. Line and Pixel coordinates for each GCP were obtained on the TRIAD system [12]. A simple linear model was then used to fit the data which contained an offset, an overall rotation, a skewness correction, and a sample scaling factor in the line and pixel directions. For the scene chosen, the results are summarized in Table VII. Using the derived transformation, UTM coordinates were determined for comparison at the GCP's so that average displacements could be found. These results show that the RTSP delivers a product which agrees with the design specification, generally has inherent skewness[3] of less than 2° and in which uncompensated errors residual errors can range from 2 to 8 pixel diameters.

Table VI: **Design Parameters for RTSP Pixel Resolution and Spacing.**

MODE	RESOLUTION (m)		—PIXEL SPACING (m)—			
			PRF/V = 2.32 (1/m)		PRF/V = 2.57 (1/m)	
	Range	Azimuth	Range	Azimuth	Range	Azimuth
Nadir	4.8	6.8	4.0	4.31	4.0	3.89
Narrow Swath	4.8	6.8	4.0	4.31	4.0	3.89
Wide Swath	18.7	10.9	15.0	6.90	15.0	6.22

Table VII: **Gross Geometric Distortions in Real-time Data Product.**

PRF/V	ALTITUDE	—SCALING—			SKEWNESS	DISPLACEMENT
		Range		Azimuth		
		Ground	(Slant)			
(1/m)	(ft)	(m)	(m)	(m)	(deg)	(m)
2.32	10000	4.24	(3.99)	4.28	1.52	17.0 ± 2.8
2.32	12000	4.29	(4.00)	4.35	1.18	8.8 ± 0.8
2.57	16000	4.33	(3.97)	3.91	0.76	9.1 ± 1.5
2.57	16000	4.35	(3.98)	3.89	2.19	34.8 ± 4.3

3.4 Speckle Statistics.

Radar image pixel intensity variability (speckle) is an inevitable consequence of the coherent summation of the scattered field from randomly placed scattering centres. For high resolution SAR systems, speckle is always present in the images of areas *e.g.* fields, for which the backscatter is uniform. The radar has been designed with a multilook, real-time processor which reduces the effect of speckle while maintaining adequate resolution for civilian remote sensing applications. The RTSP creates separate images by bandpass filtering the azimuth spectral data and then summing these appropriately to create a final output image.

The output pixel values for each of the seven looks are proportional to the scattered field intensity, not to scattered power. Consequently, if we assume Rayleigh type scattering [5] from a uniform terrain area, with N looks, the following relation can be shown [17] between the standard deviation, S, of the pixel values; and the mean, $< V >$.

$$\frac{S}{< V >} = \frac{0.523}{N^{\frac{1}{2}}} \tag{3}$$

The looks are not entirely statistically independent and thus the effective number of looks is always slightly less than the number selected.

Figure 7 shows a comparison of the actual data (small circles) compared to a continuous curve representing the probability density function predicted for averaging 6 independent looks. The good agreement indicates that in practice the radar has achieved six independent looks with 7 looks processed.

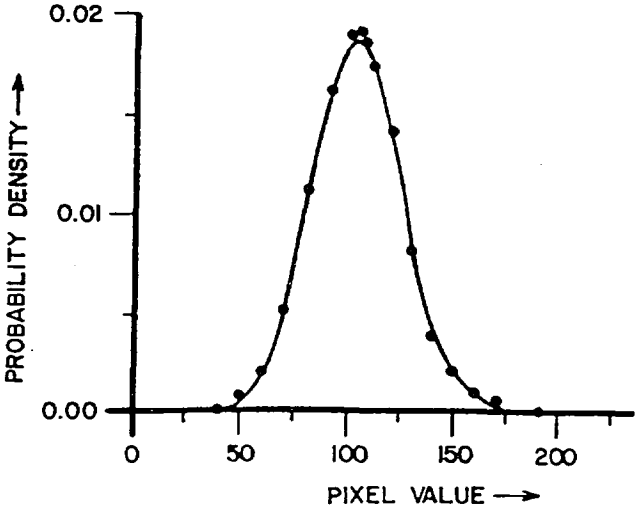

Figure 7: Speckle Statistics from the RTSP.
A comparison is given of actual RTSP data (small circles) obtained from a featureless field in a narrow swath image and a theoretical Rayleigh distribution of 6 looks. The theoretical distribution was calculated using a random number generator with zero mean and appropriate standard deviation to simulate the I and Q components of the scattered field. The actual data is marginally narrower and higher than the theoretical distribution indicating the RTSP has achieved slightly in excess of 6 looks.

3.5 Ambiguity Figures.

The Doppler history of a target passing through the SAR azimuth beamwidth can only be observed correctly if there are enough pulses (i.e. phase measurements) to sample the full range of the Doppler frequencies. Using the Nyquist criterion, this means that the radar PRF must exceed the azimuth Doppler bandwidth. As the maximum Doppler is proportional to aircraft ground speed,

[3]The skewness is a result of look-summation delay. In the implementation used in the CCRS radar, this delay is discontinuous and results in ~ 20 *jaggies* across the swath.