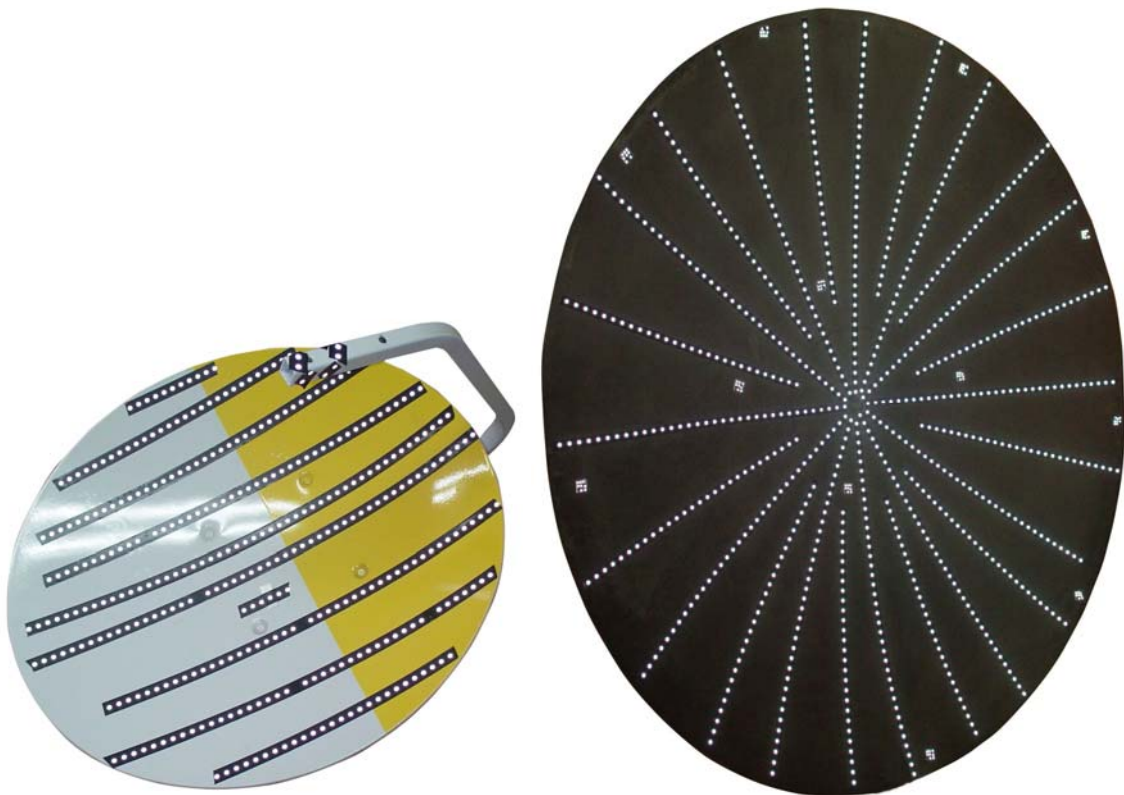




V-STARS S8 Demonstration Measurement Report



December 2004

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Object Measured

Two objects were measured as part of the V-STARs demonstration. The first object was a small (0.45m) parabolic antenna. The object is shown on the cover of this report. The second object was a larger (2m) shaped antenna. This is also shown on the cover of this report.

The primary objective of this measurement was to determine the coordinates of targets attached to the surfaces of the antennas. This data was then used to create a parabolic model in the case of the small antenna and compared to the CAD surface in the case of the large antenna.

Equipment Used

1. V-STARs S6 INCA2 Camera (INCA3 camera shown in image below)
2. Scale Bars
3. AutoBar
4. Coded targets
5. Surface targets



Small Antenna Measurement Objectives

1. Demonstrate INCA2 camera use
2. Determine location of key points on surface
3. Fit parabolic surface

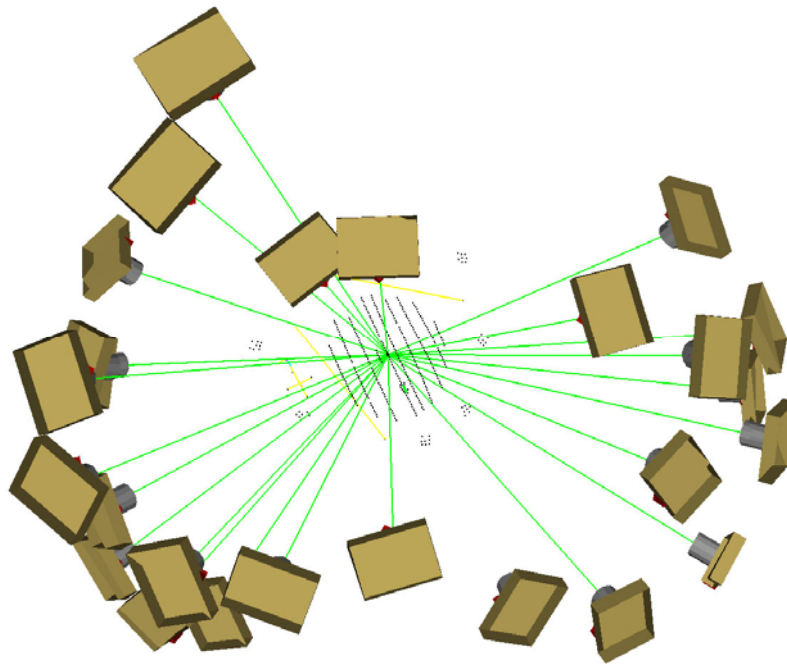
Small Antenna Targeting

1. AutoBar for initial coordinate system
2. Reference coded targets to tie photography together
3. Two scale bars
4. Surface targets

Small Antenna Measurement Statistics

INCA2	
No. of photos	26
No. of points	424
Accuracy RMS X,Y,Z	
X	0.004mm
Y	0.003mm
Z	0.003mm
Scale Agreement = 0.020mm	

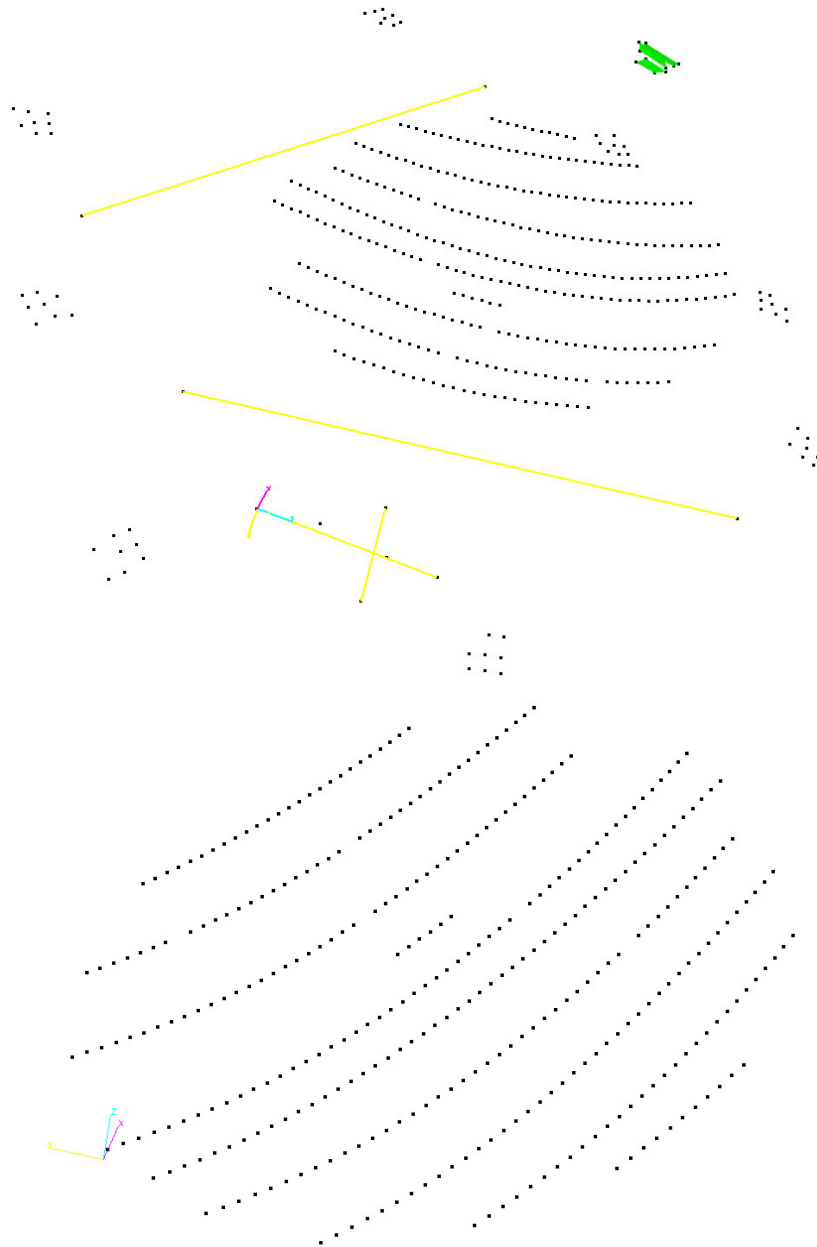
The diagram below illustrates the geometry used to create the point cloud for the antenna.



Network - Top View

Small Antenna Point Cloud

The point cloud produced is shown below:

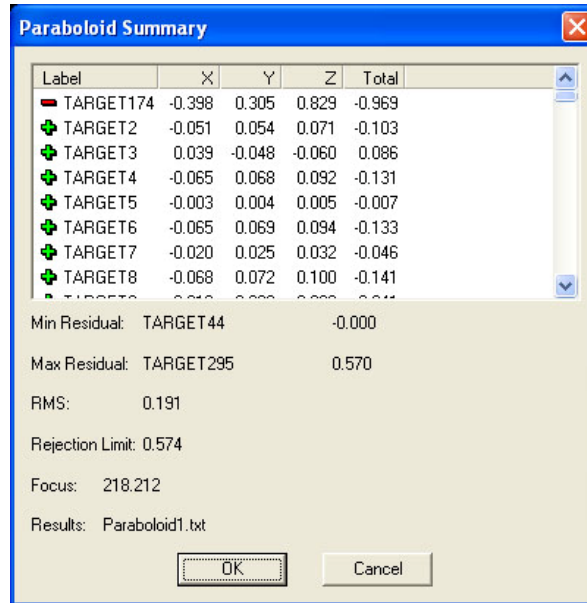


Small Antenna Alignment

No alignment was carried out.

Small Antenna Analysis

One point (TARGET174) on the antenna was artificially raised to show a deviation. The point data was used to create the following parabolic surface.

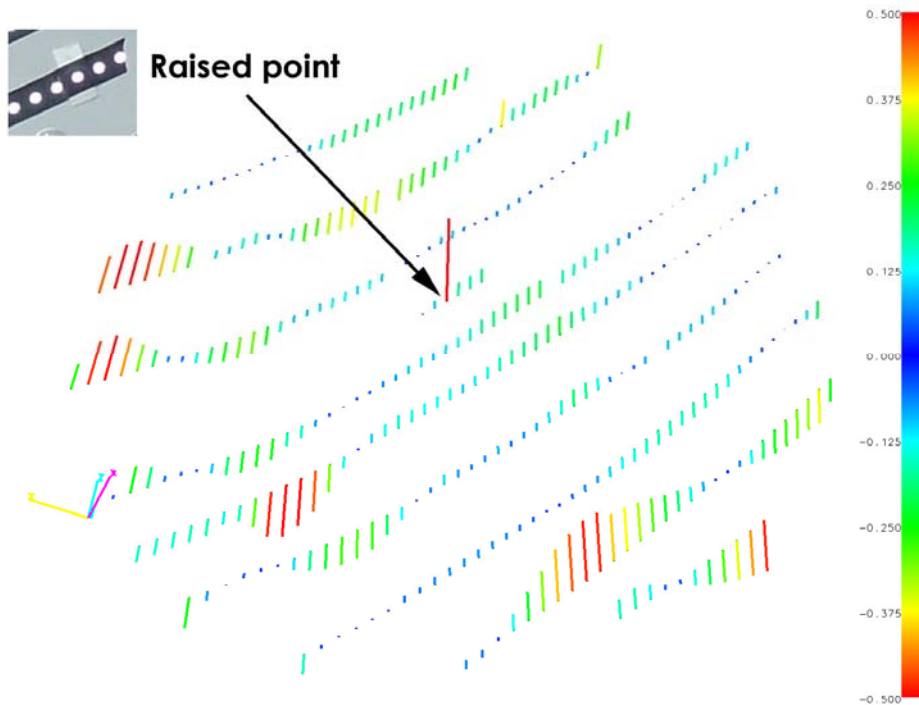


The image shows a 'Paraboloid Summary' dialog box with a table of target data and summary statistics.

Label	X	Y	Z	Total
TARGET174	-0.398	0.305	0.829	-0.969
TARGET2	-0.051	0.054	0.071	-0.103
TARGET3	0.039	-0.048	-0.060	0.086
TARGET4	-0.065	0.068	0.092	-0.131
TARGET5	-0.003	0.004	0.005	-0.007
TARGET6	-0.065	0.069	0.094	-0.133
TARGET7	-0.020	0.025	0.032	-0.046
TARGET8	-0.068	0.072	0.100	-0.141

Summary statistics:
Min Residual: TARGET44 -0.000
Max Residual: TARGET295 0.570
RMS: 0.191
Rejection Limit: 0.574
Focus: 218.212
Results: Paraboloid1.txt

As expected, the point TARGET174, shows a high deviations value. This is shown graphically in the image below:



Small Antenna Time Summary

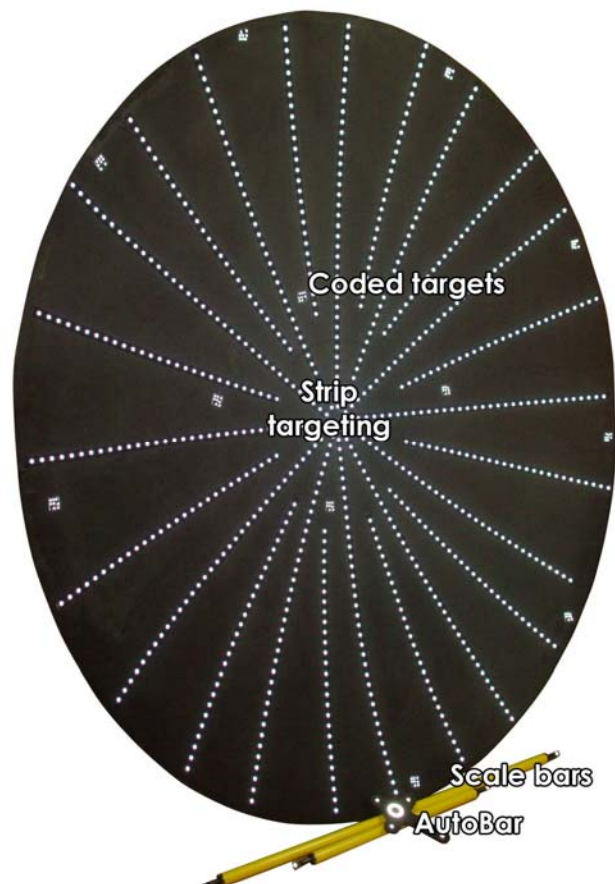
Initial Investigation	2 minutes
Targeting	1 minutes
Photography	1 minutes
Processing	1 minutes
Analysis	2 minutes
Total	7 minutes

Large Antenna Measurement Objectives

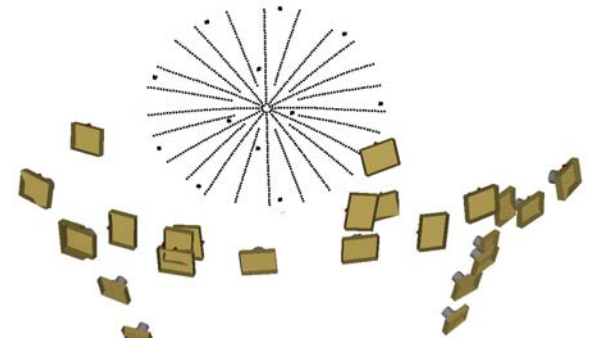
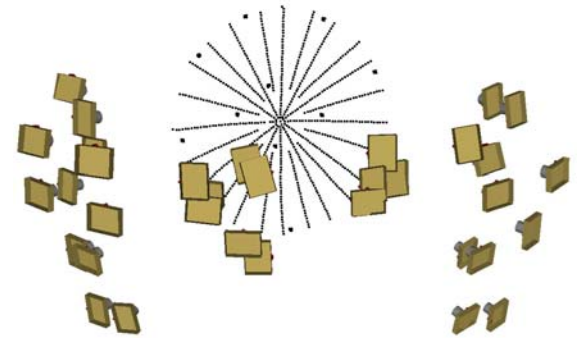
1. Determine location of key points on surface
2. Align and measure surface to supplied CAD surface
3. Measure the antenna in a 0° and 90° orientation

Large Antenna Targeting

1. AutoBar for initial coordinate system
2. Reference coded targets to tie photography together
3. Two scale bars
4. Surface targets

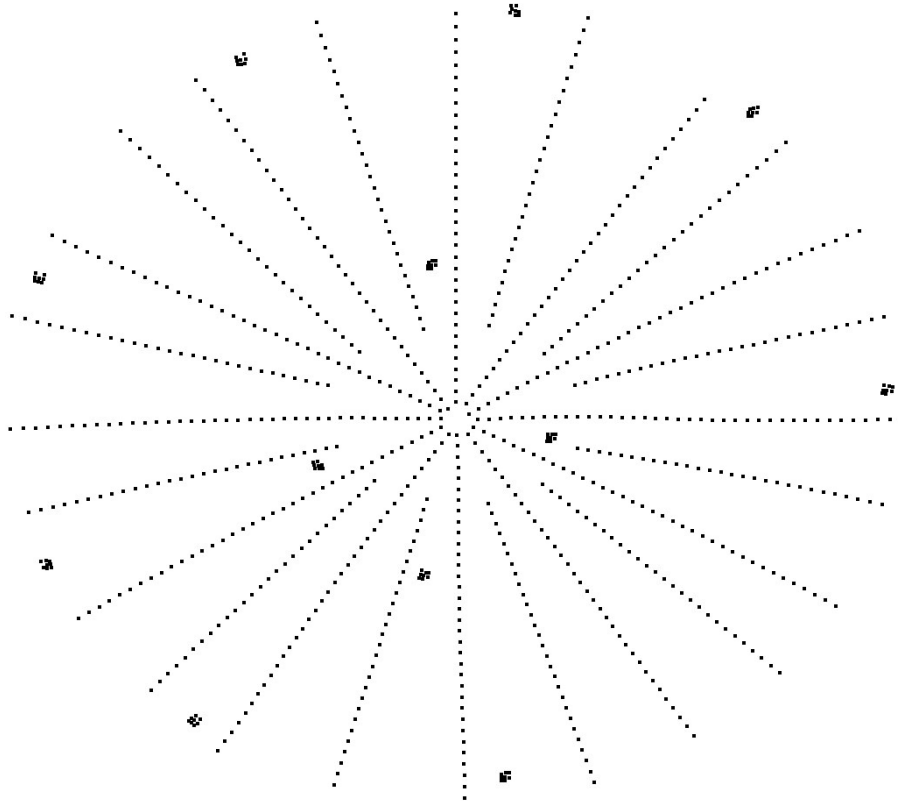


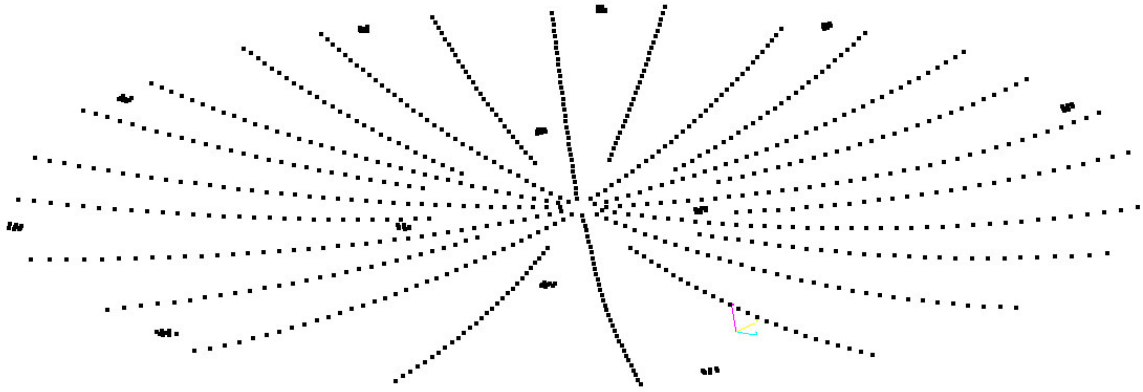
Large Antenna Measurement Statistics

0° Network		90° Network	
No. of photos	24	No. of photos	34
No. of points	876	No. of points	876
Accuracy RMS X,Y,Z		Accuracy RMS X,Y,Z	
X	0.006mm	X	0.003mm
Y	0.006mm	Y	0.004mm
Z	0.004mm	Z	0.006mm
Scale Agreement = 0.020mm		Scaled from first network	
			

Large Antenna Point Cloud

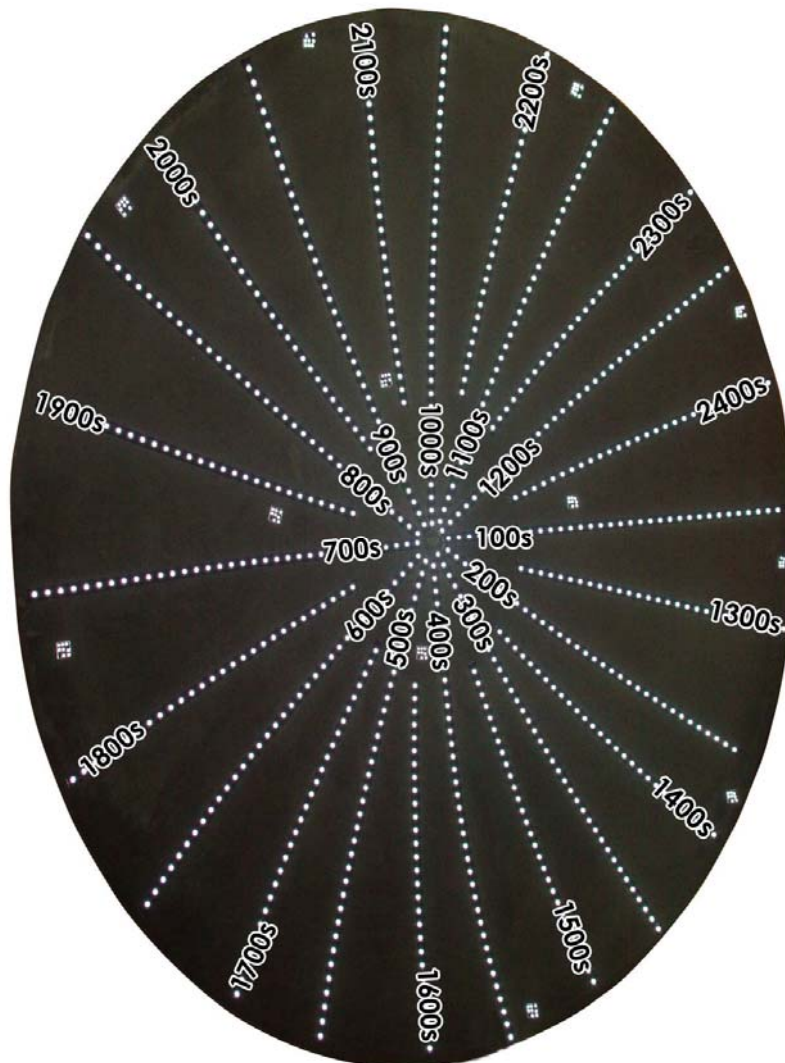
The point cloud produced on the 0° orientation is shown below:

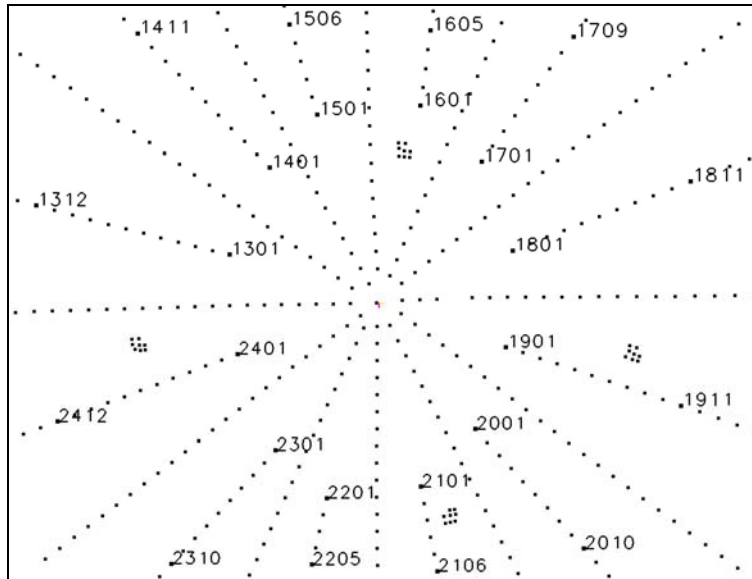
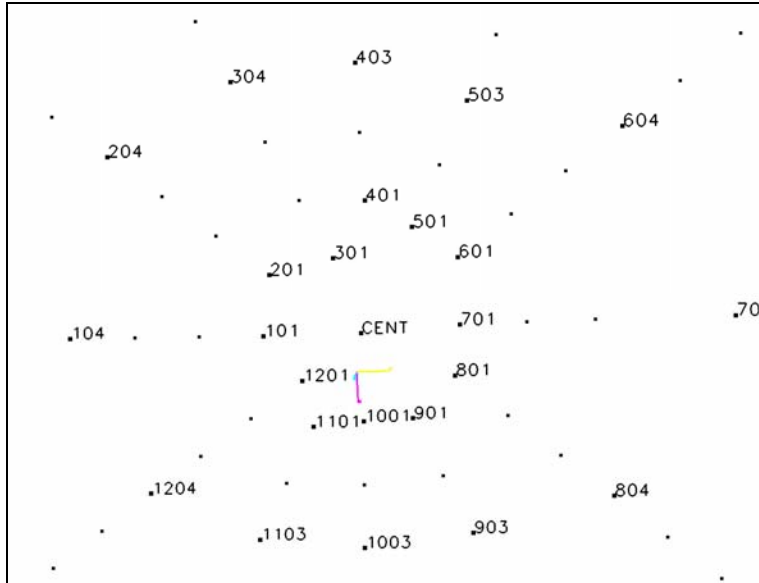




Large Antenna Numbering

The points on the antenna were named as shown in the image below:



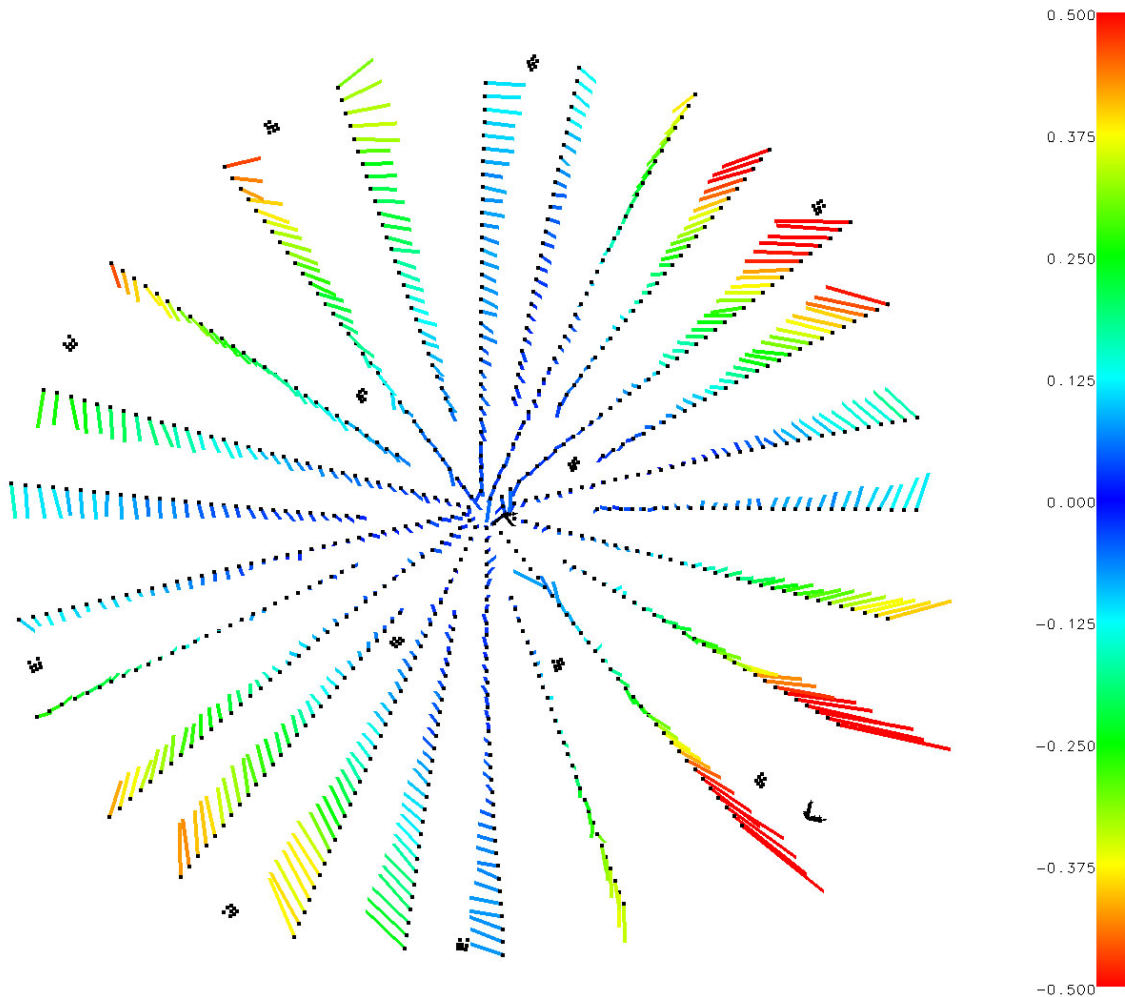
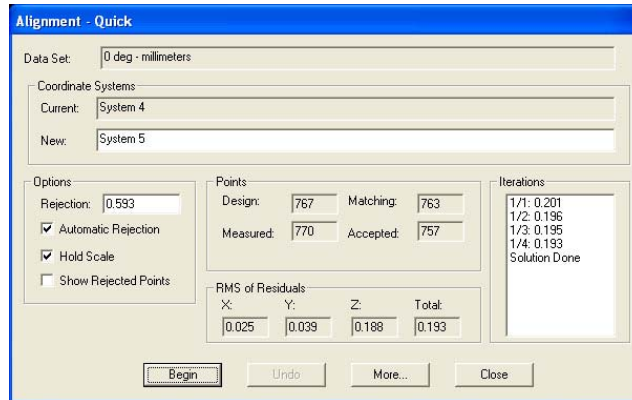


Large Antenna Alignment

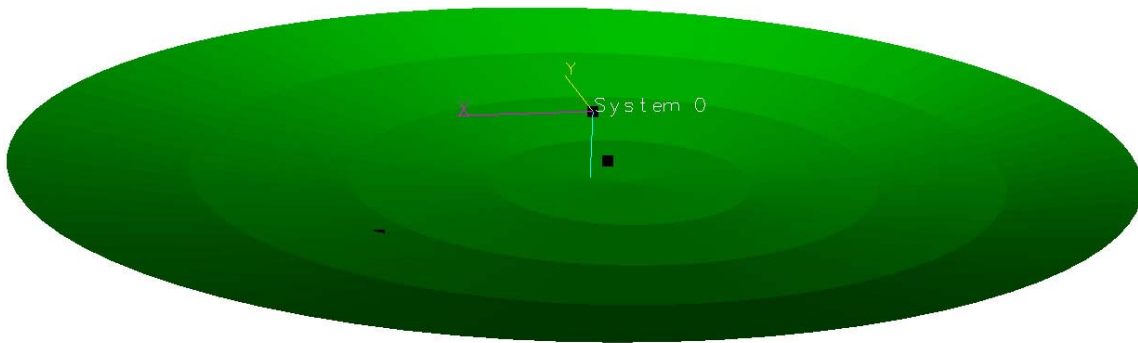
In order to compare the data to the supplied CAD file it was necessary to complete a data alignment. In most cases common points are available between the two coordinate system to facilitate an alignment. In this case it was necessary to manipulate the data in order to get the points into the same coordinate system as the CAD data. Examination of the CAD data revealed an origin offset as well as a change of sign in the Z direction. To align the data it was necessary to change the sign in the Z direction and then apply an offset correction. The data alignment is by no means perfect, but it is still very representative of the actual alignment.

Large Antenna Analysis

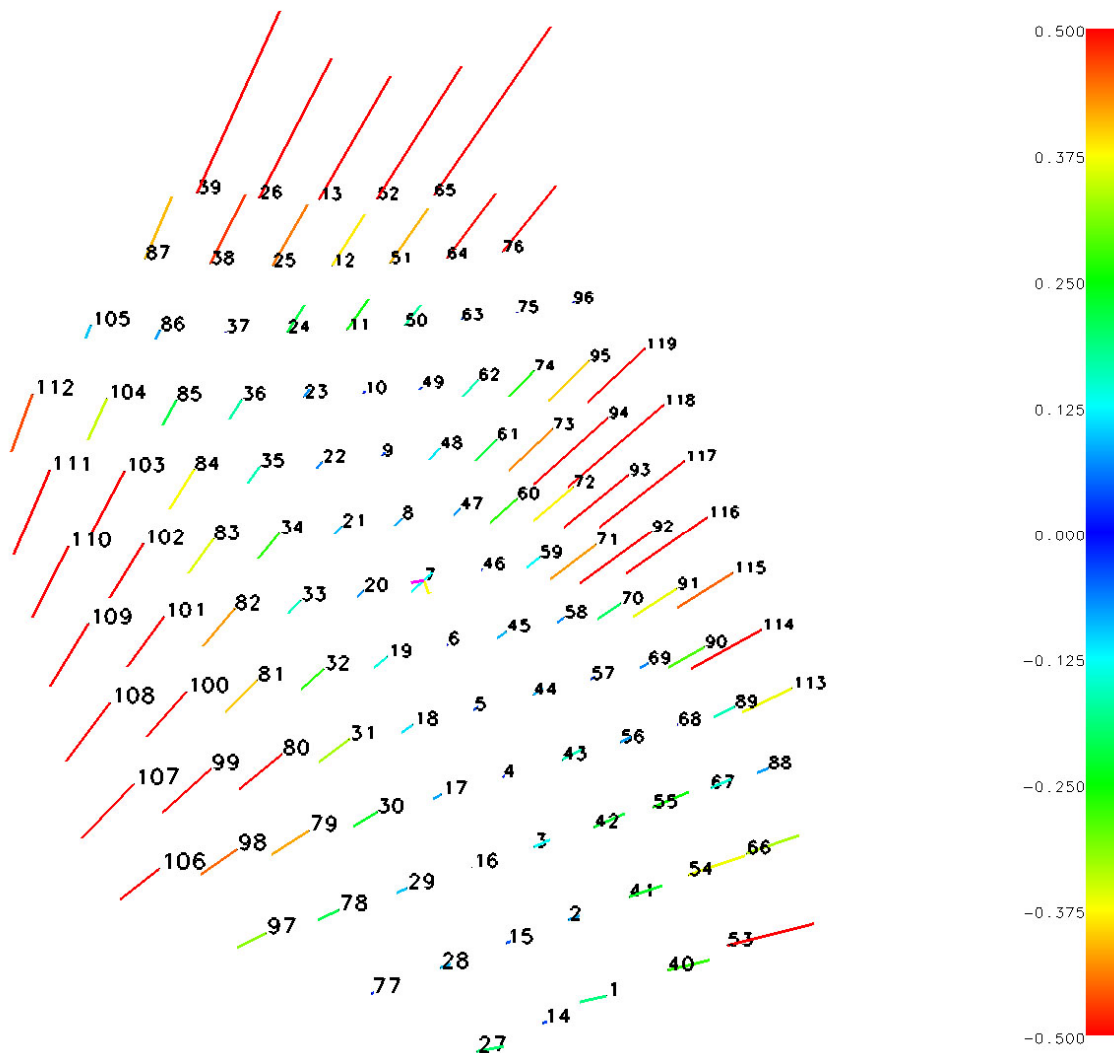
The 0° and 90° coordinate sets were compared to each other to produce the following deviations. These deviations indicate the movement of the targets when the antenna is turned 90°. The individual values are available in a separate .txt file.



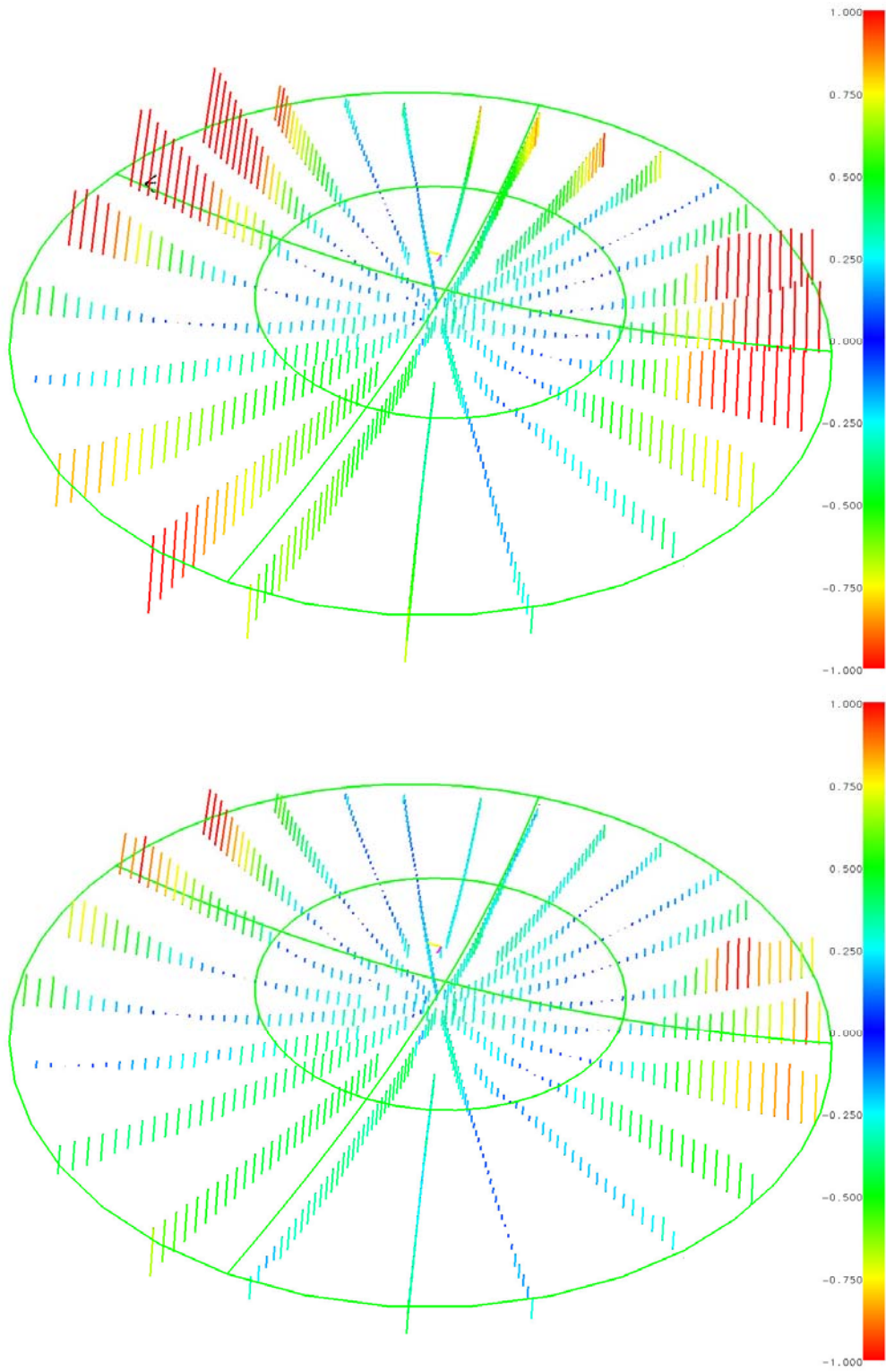
The CAD model supplied is shown in the image below:



The data below shows a graphical representation of the data supplied by the customer. This was the data collected on a CMM of the same antenna.



The data deviations for the 0° and 90° cases are shown below. The individual values are available in a separate .txt files.



Large Antenna Time Summary

Initial Investigation	2 minutes
Targeting	10 minutes
Photography 0°	3 minutes
Processing 0°	2 minutes
Photography 90°	3 minutes
Processing 90°	2 minutes
Analysis	10 minutes
Total	32 minutes

Concluding Remarks

The measurement undertaken has shown that V-STARS can be a very powerful measurement tool. The results of the measurement undertaken were very accurate and produced quickly. With the use of the PRO-SPOT target projection system the V-STARS could potentially measure approximately 22,000 points on the surface in about half the time of a regular measurement.