Geodetic Services

V-STARS E3H and PRO-SPOT Demonstration
Measurement Report for Samsung Heavy Industries
Geoje Shipyard, Korea

OCT 2003

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Objects Measured

Two objects were measured as part of the V-STARS E3H and PRO-SPOT demonstration. The first object was a large ship section. The objective of the measurement was to determine some of the key dimensions. The second object was a small section of curved plate. This is shown on the cover of this report. The objective in this measurement was to determine the surface using the PRO-SPOT target projector and strip tape.

Equipment Used

1. V-STARS E3H Camera System
2. Various targets
3. Scale Bar
4. PRO-SPOT Target Projector.

Key Measurement Objectives

1. Demonstrate camera use and object targeting
2. Calculate key dimensions on block
3. Demonstrate use of PRO-SPOT
4. Compare data to design data.

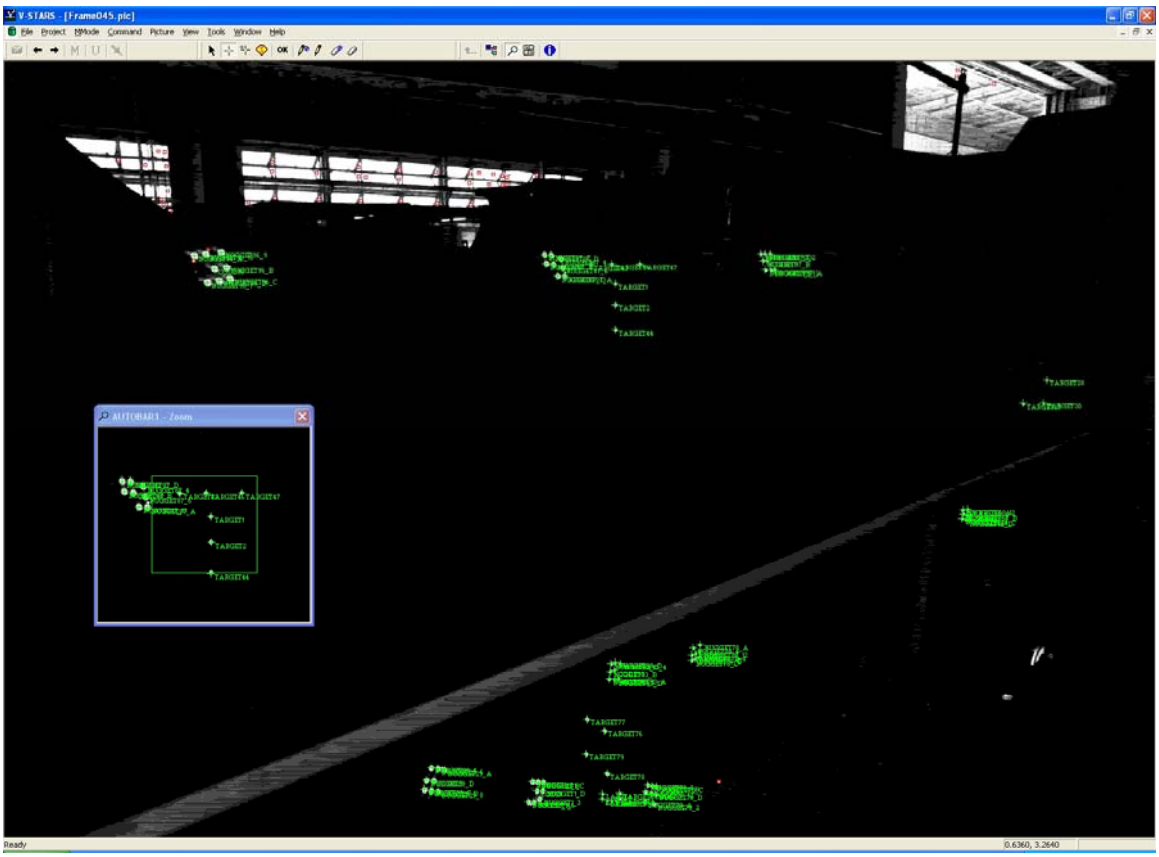
Ship Section Targeting

1. AutoBar for initial coordinate system
2. Coded targets to tie photography together
3. Targets on key planes
4. Edge Targets
5. One scale bar

Ship Section Measurement Statistics

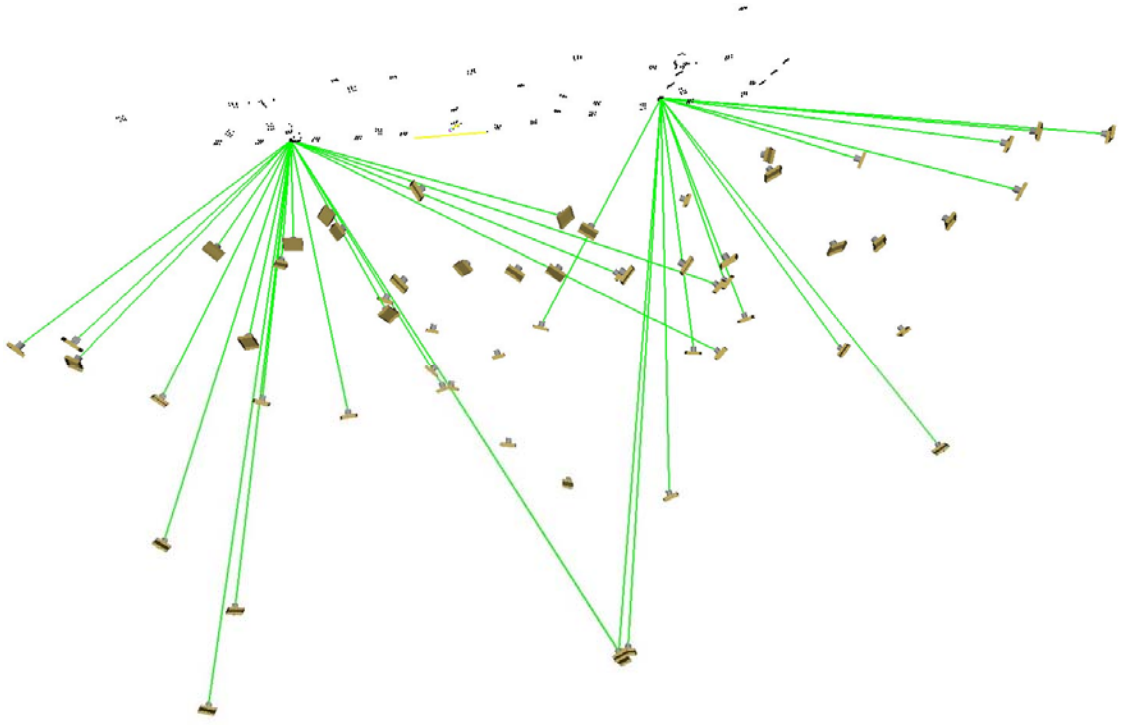
Network

No. of photos	59	
No. of points	359	
Accuracy RMS X,Y,Z	X	0.040
	Y	0.030
	Z	0.033

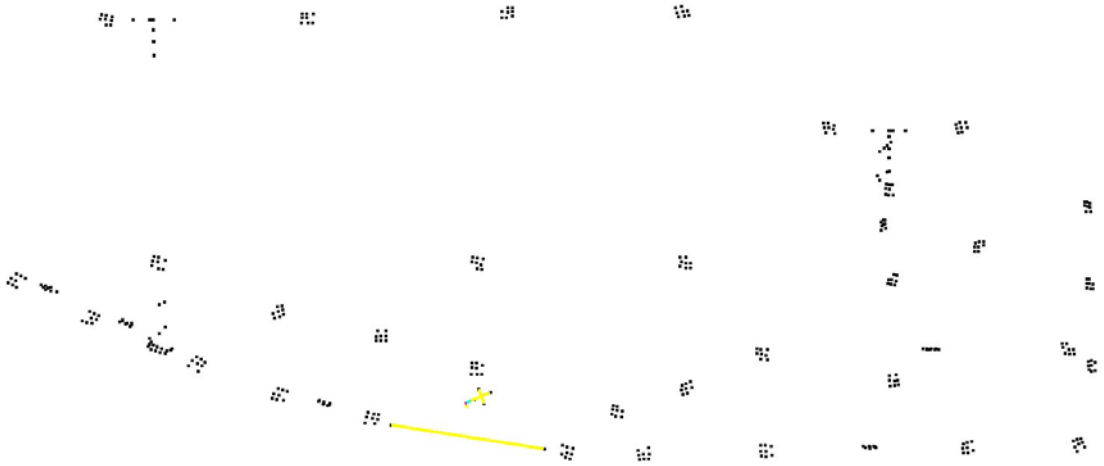


Typical V-STARS measurement image

The diagram below illustrates the geometry used to create the point cloud. Two points have been highlighted to show the measurement observations (rays) used to determine its XYZ coordinate.



The final V-STARS point cloud is shown in the images below:



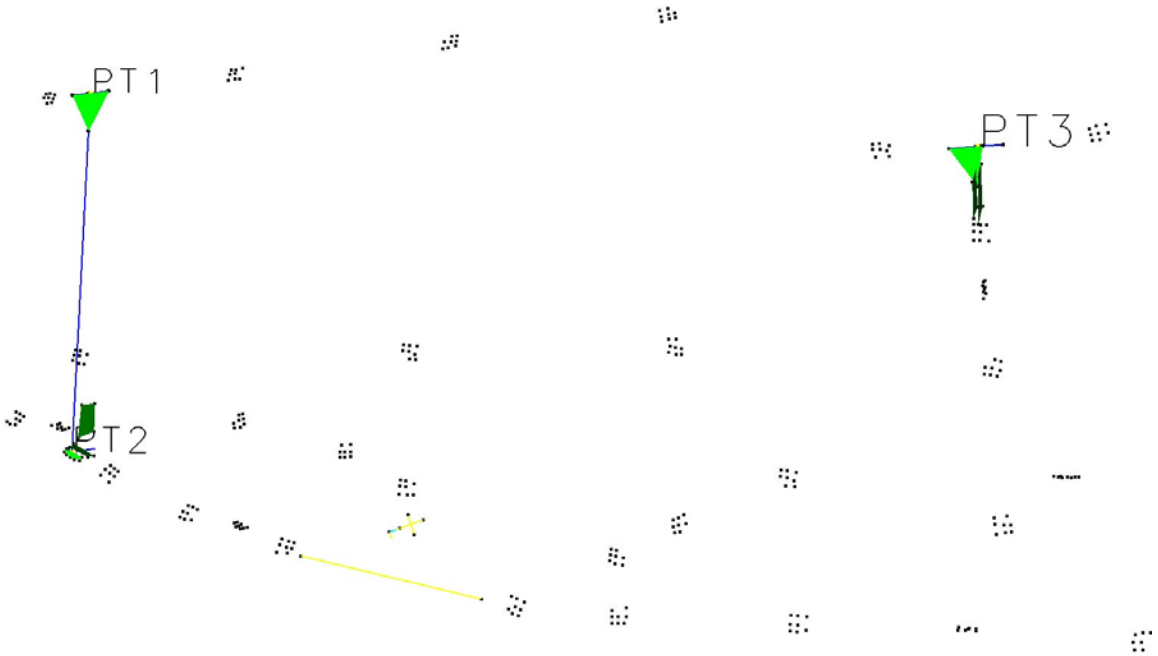
Side View

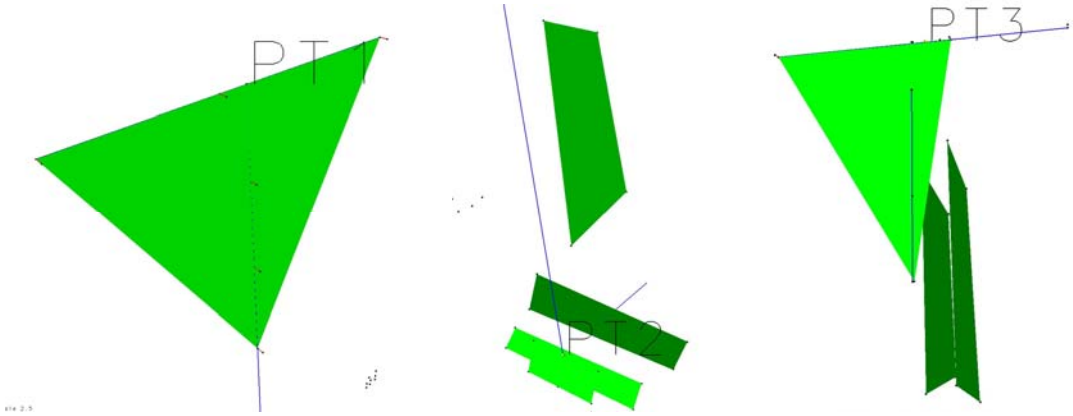
Ship Section Alignment

No alignment was undertaken for this measurement.

Ship Section Analysis

The data was used to create best fit planes, lines, and intersection points. The model showing some of the analysis aspects is shown below. The three points that were computed are also shown.





Point	X	Y	Z
PT1	570.979	2966.588	960.646
PT2	573.631	990.968	1638.242
PT3	796.898	763.119	3185.188

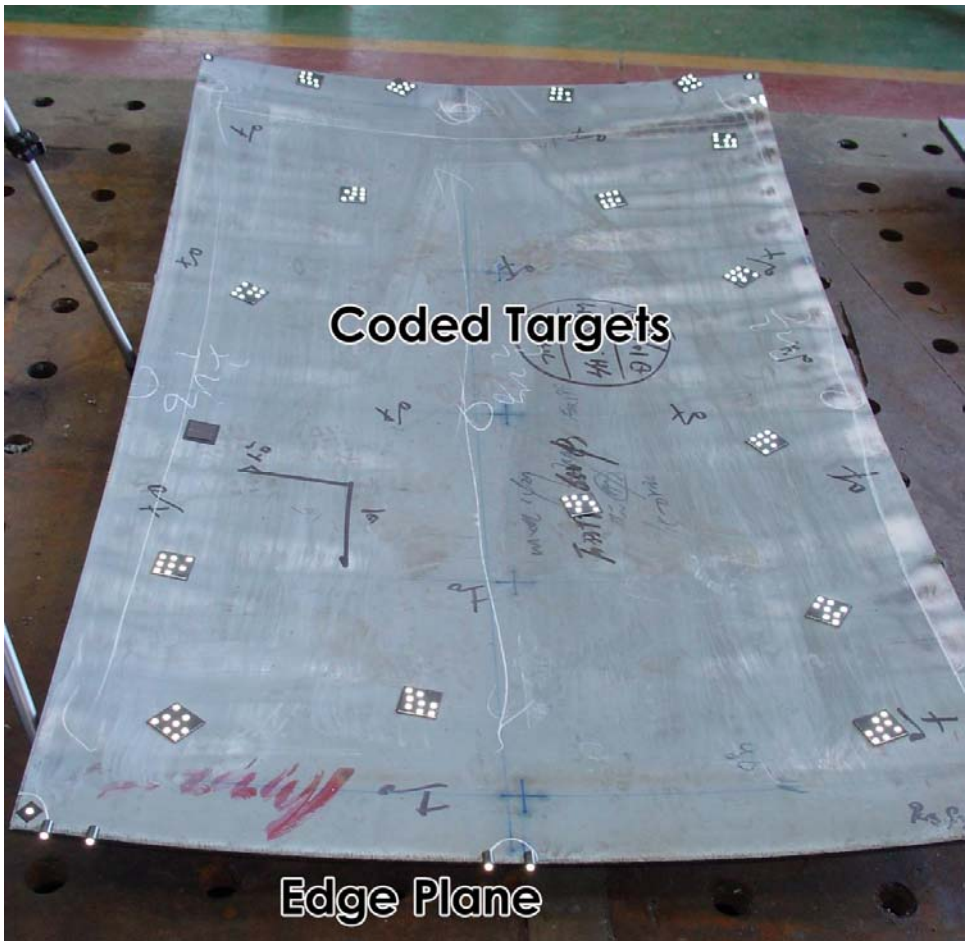
Point to Point	Distance
PT1 – PT2	2088.592
PT2 – PT3	5019.536
PT1 - PT3	4890.225

Ship Section Time Summary

Initial Investigation	5 minutes
Targeting	20 minutes
Photography	10 minutes
Processing	15 minutes
Data Analysis	10 minutes
Total	**60 minutes**

Curved Plate Targeting

1. AutoBar for initial coordinate system
2. Coded targets to tie photography together
3. Targets to define the edge planes.
4. Strip tape surface targets
5. PRO-SPOT projected targets
6. One scale bar

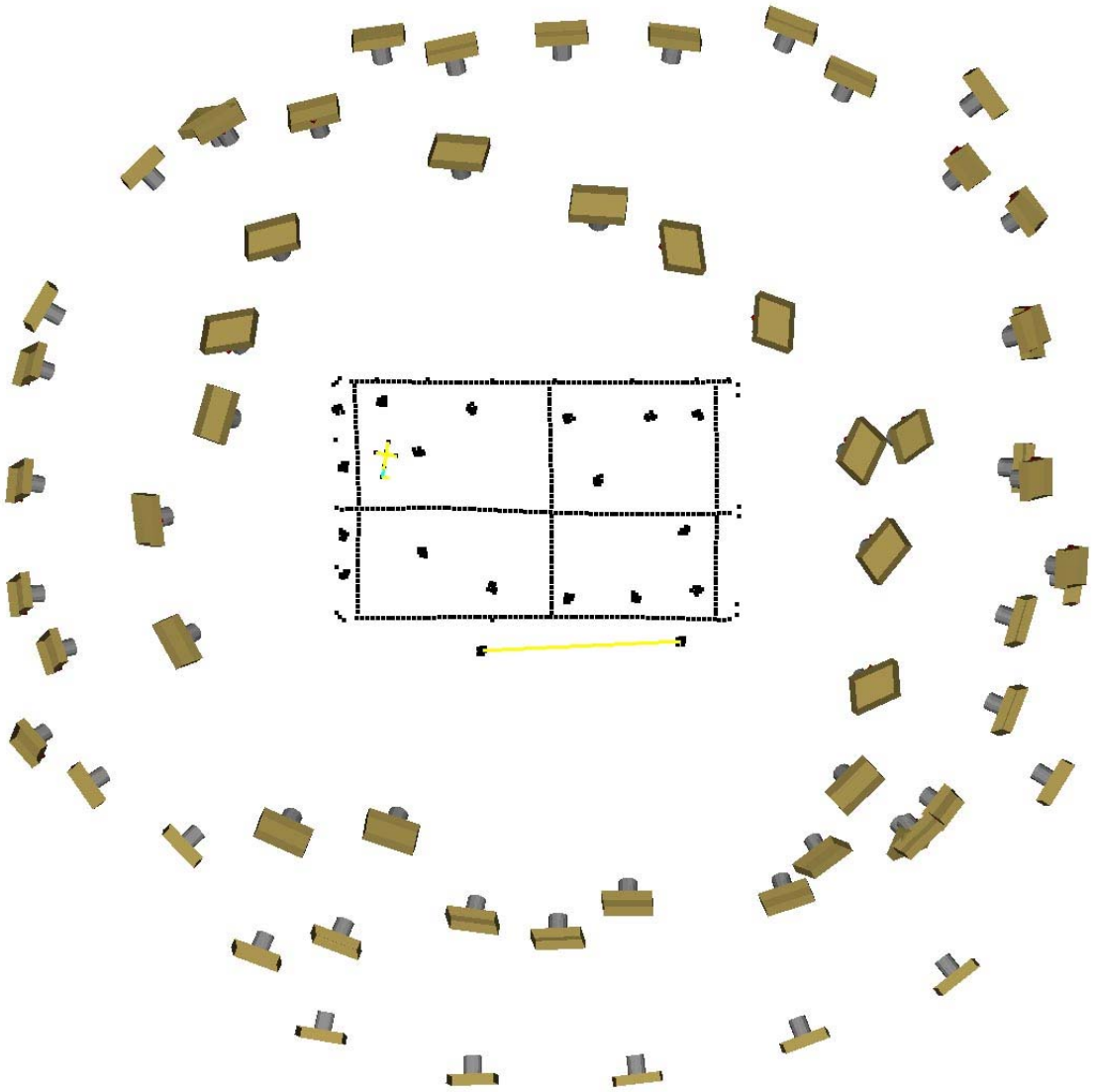


Curved Plate Measurement Statistics

Network 1 – Strip Tape

No. of photos	61	
No. of points	589	
Accuracy RMS X,Y,Z	X	0.013
	Y	0.014
	Z	0.014

The diagram below illustrates the geometry used to create the point cloud. The final V-STARS point cloud is shown in the images below:



Top View

Network 2 – PRO-SPOT Targets Part 1

No. of photos	22	
No. of points	4048	
Accuracy RMS X,Y,Z	X	0.027
	Y	0.018
	Z	0.018

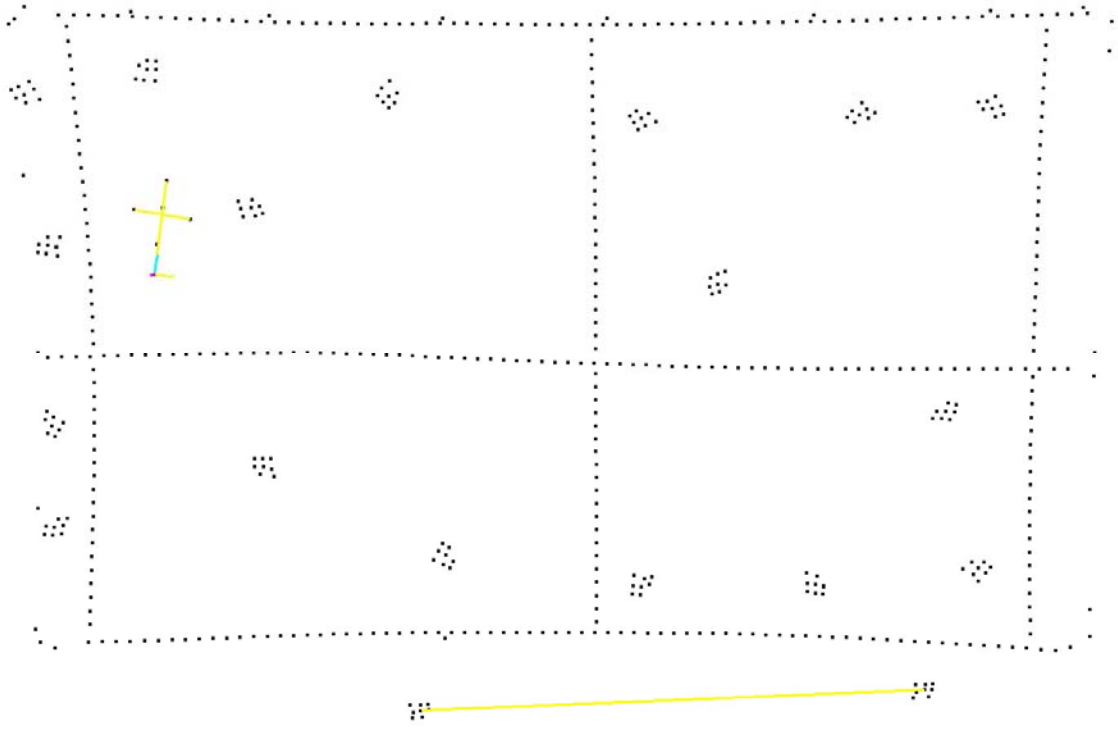
Network 3 – PRO-SPOT Targets Part 2

No. of photos	27	
No. of points	4295	
Accuracy RMS X,Y,Z	X	0.023
	Y	0.019
	Z	0.025

Curved Plate Point Clouds

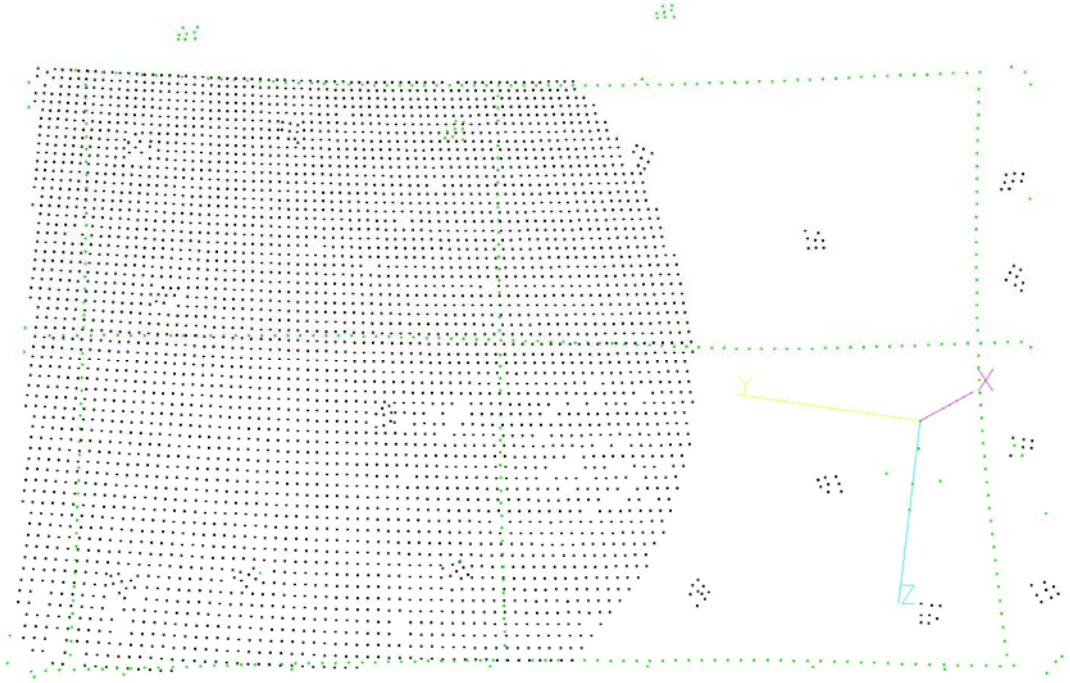
Network 1 – Strip Tape

The final point cloud from the first network is shown below.



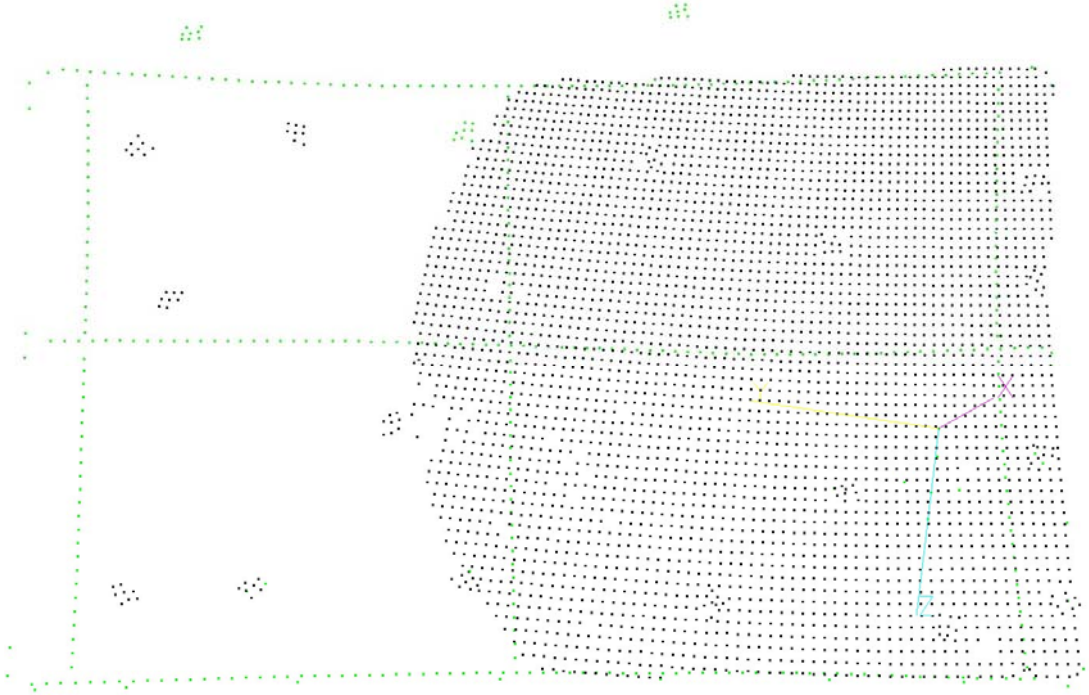
Network 2 – PRO-SPOT Targets Part 1

The final point cloud from the second network is shown below.



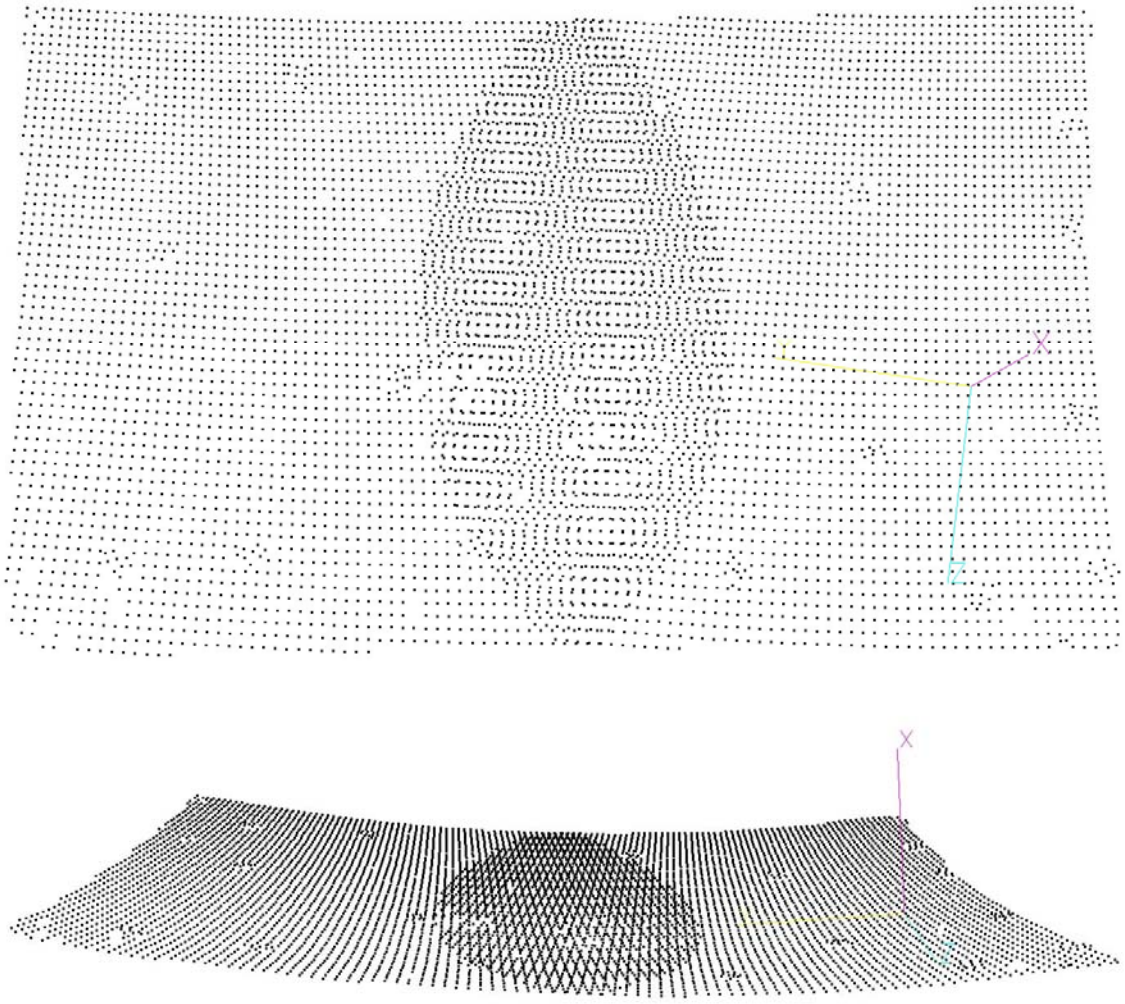
Network 3 – PRO-SPOT Targets Part 2

The final point cloud from the third network is shown below.



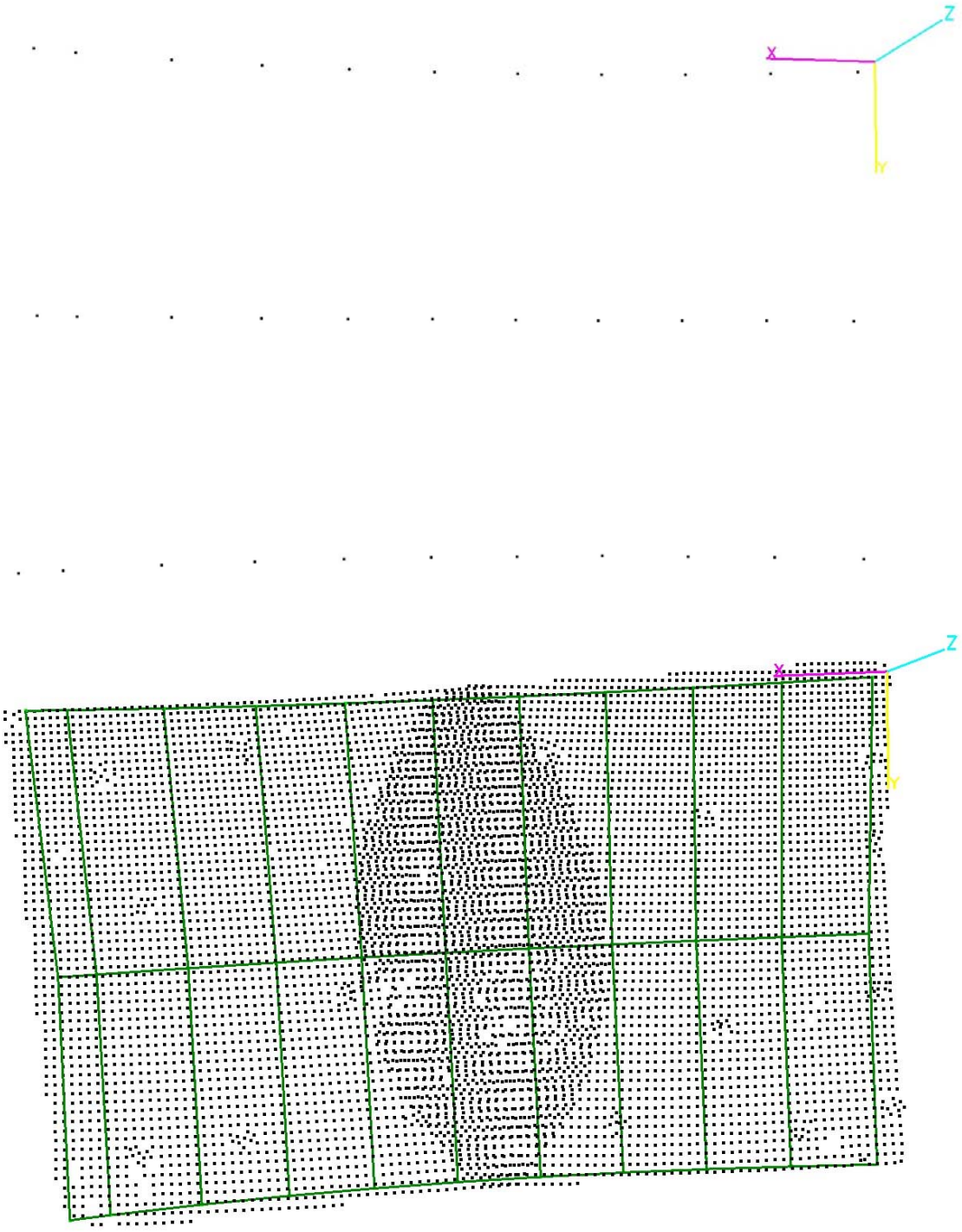
Combined PRO-SPOT Networks

The final point cloud from the combined PRO-SPOT networks is shown in the images below.



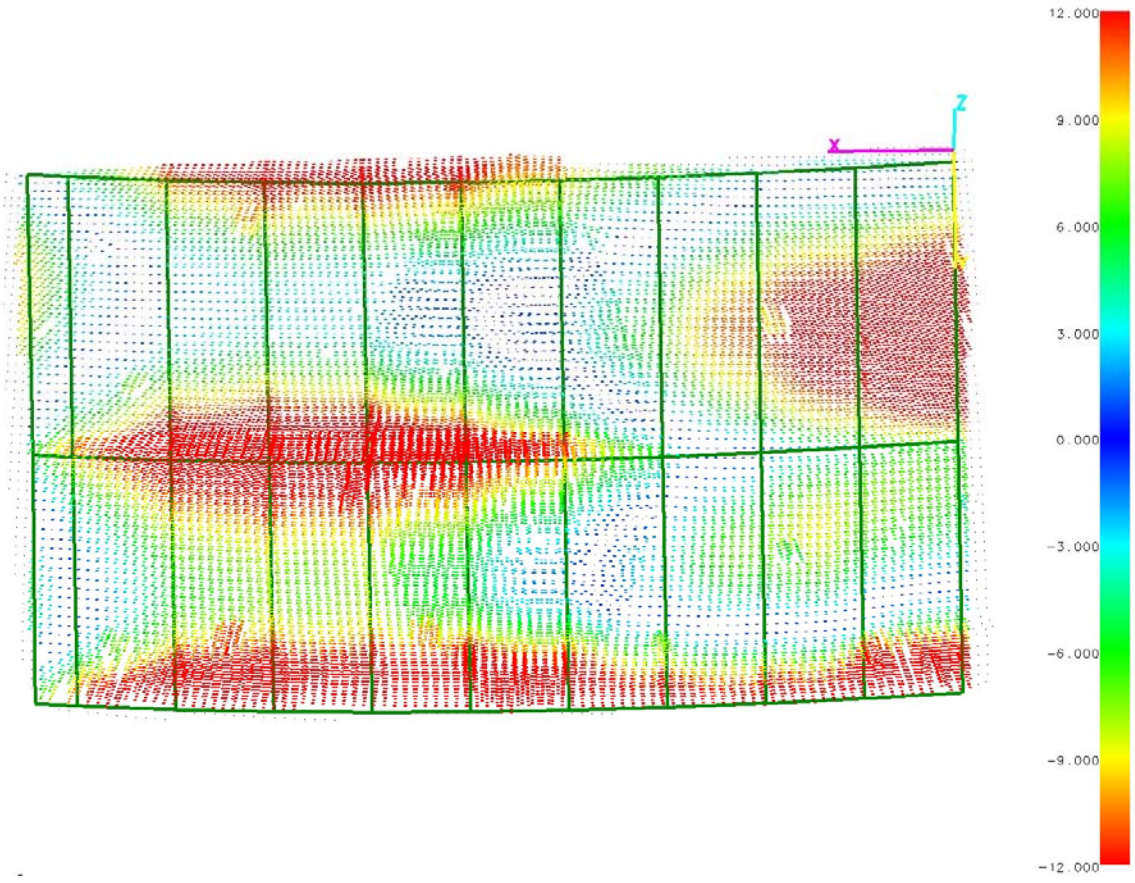
Curved Plate Alignment

The nominal data that was provided was used as a basis for a rough alignment. The data is shown in the image below.



Curved Plate Analysis

The aligned point clouds were compared to the planes formed my connecting the adjoining grid points. The color map is shown in the image below. This image is similar to the one that would be seen if the data was compared to a CAD model of the part.



Curved Plate Time Summary

Network 1 – Strip Tape

Initial Investigation	1 minutes
Targeting	5 minutes
Photography	2 minutes
Processing	5 minutes
Data Analysis	5 minutes
Total	**18 minutes**

Network 2 & 3 – PRO-SPOT Targets Part 1 & 2

Initial Investigation	1 minutes
Targeting	10 minutes
Photography	8 minutes
Processing	10 minutes
Data Analysis	10 minutes
Total	**39 minutes**

Concluding Remarks

The measurement undertaken has shown that V-STARS with the E3H system and PRO-SPOT can be a very powerful measurement tool. The results of the measurement undertaken were very accurate and more importantly were produced quickly.

GSI would like to thank Samsung Heavy Industries for welcoming us into their facility. We will be happy to discuss the results of this report or any other aspect of the technology presented.