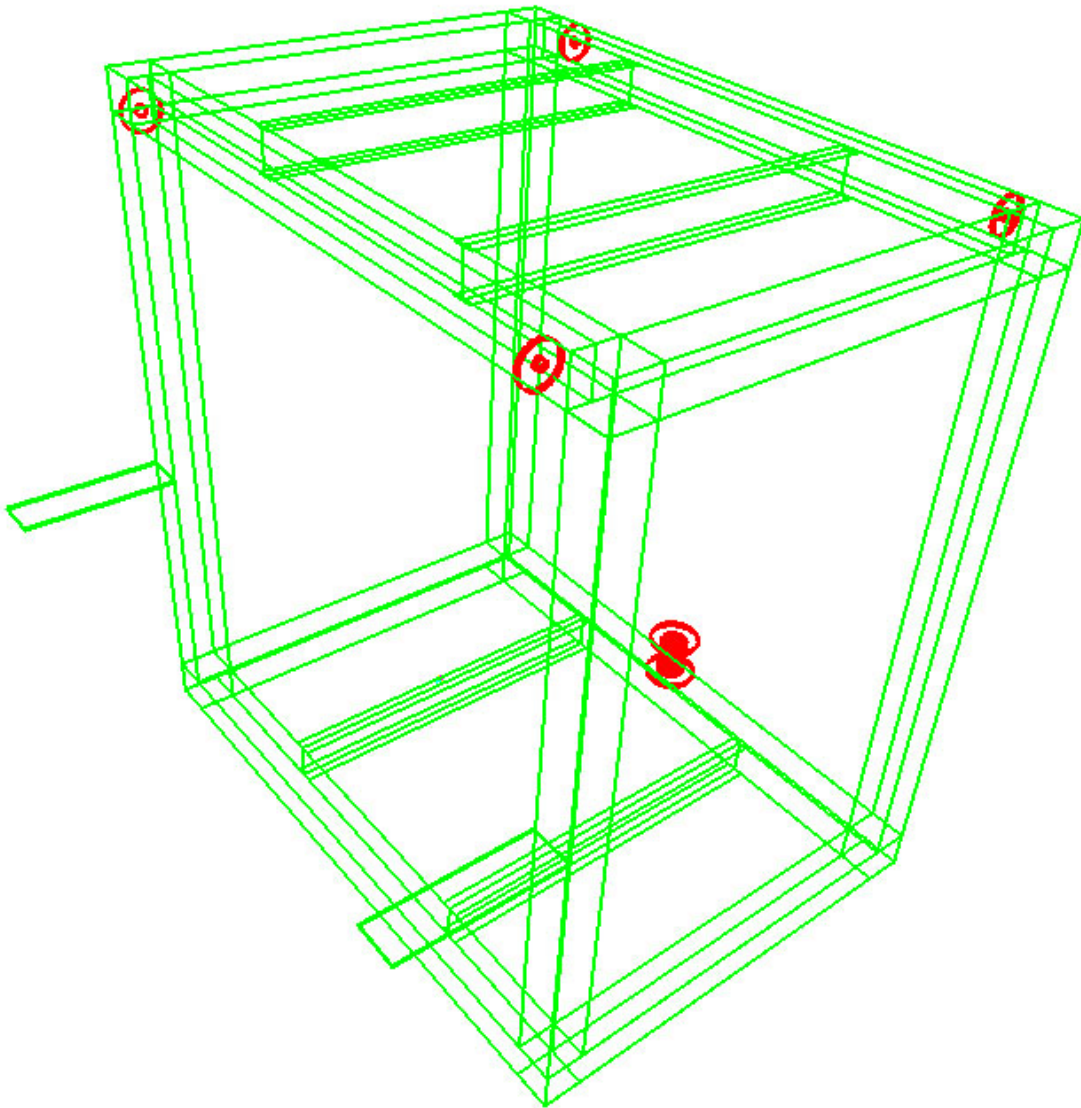




V-STARS E3X Demonstration Measurement Report



MAY 2003

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Object Measured

One object was measured as part of the V-STARS E3X demonstration. The object was an engineering module. A model of the object is shown on the cover of this report.

Equipment Used

1. V-STARS E3X Camera System
2. Various targets
3. Scale Bar



Objectives

1. Demonstrate camera use and object targeting
2. Calculate key dimensions
3. Determine angular relationships between planes
4. Calculate best fit cylinder

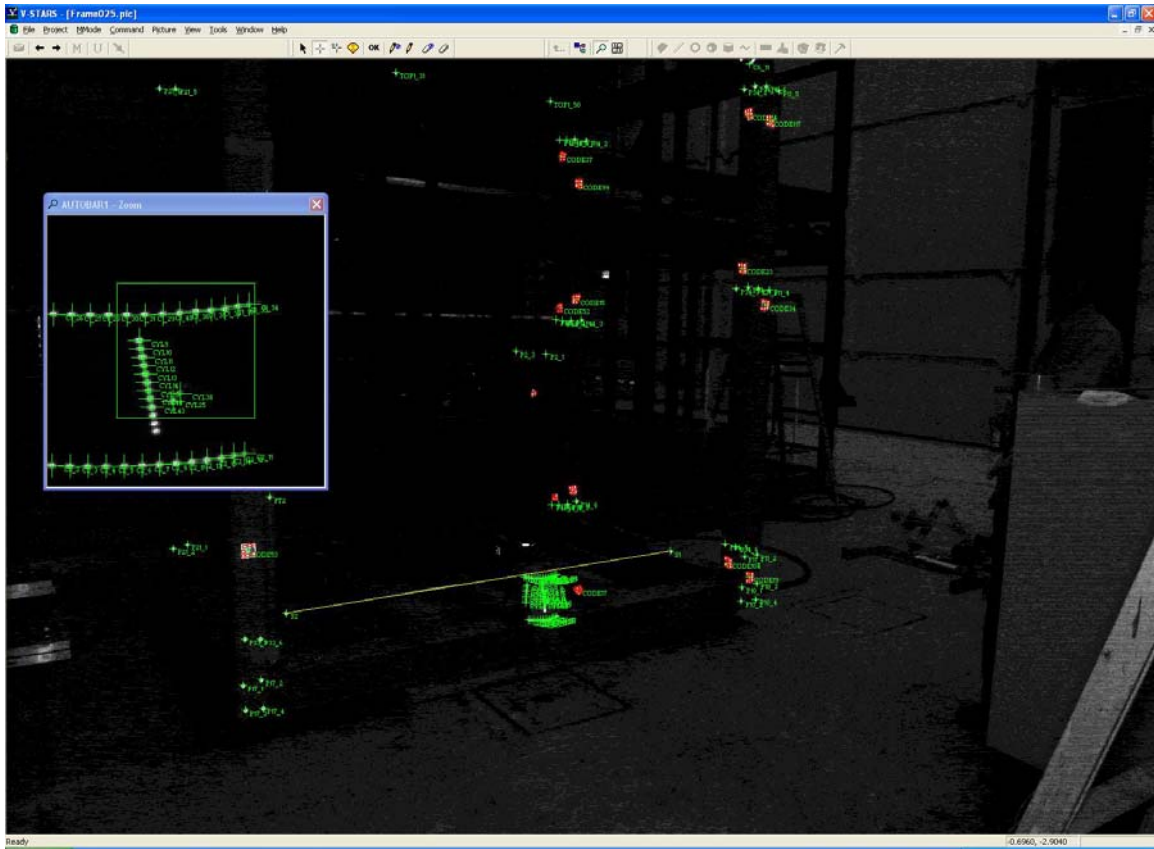
Targeting

1. AutoBar for initial coordinate system.
2. Coded targets to tie photography together.
3. Targets on key planes, circles and cylinders
4. Two scale bars.

Measurement Statistics

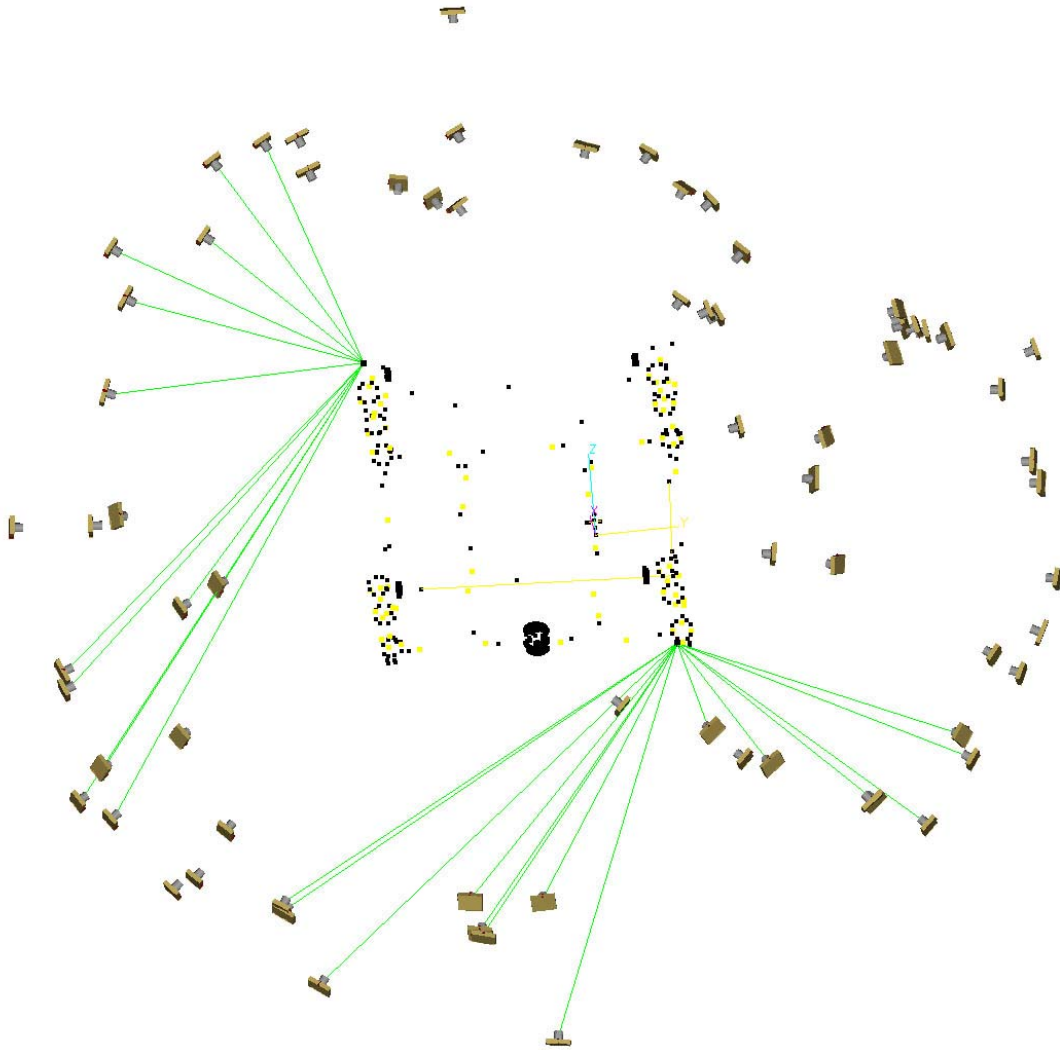
Network

| | | |
|--------------------|-----|-------|
| No. of photos | 72 | |
| No. of points | 452 | |
| Accuracy RMS X,Y,Z | X | 0.030 |
| | Y | 0.044 |
| | Z | 0.038 |

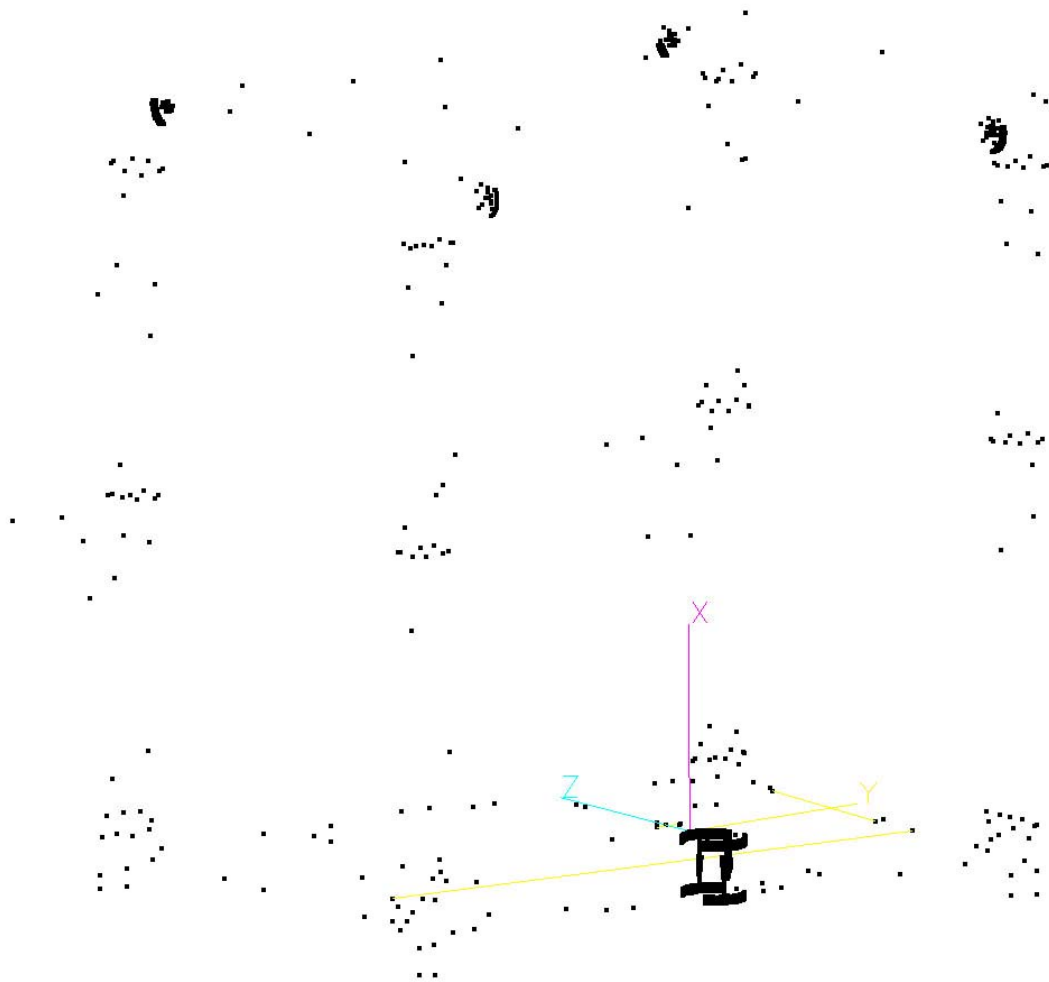


Typical V-STARS measurement image

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 below:



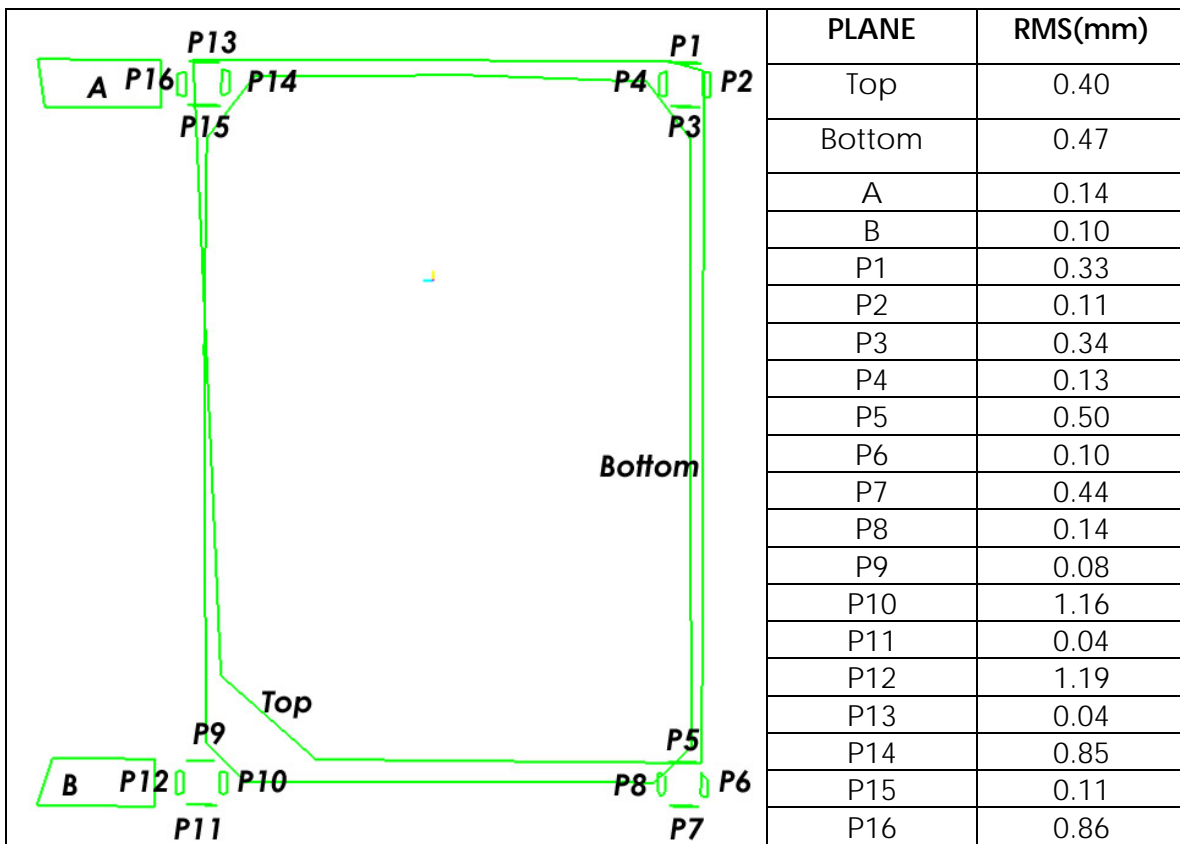
Alignment

No alignment was carried out on the data.

Analysis

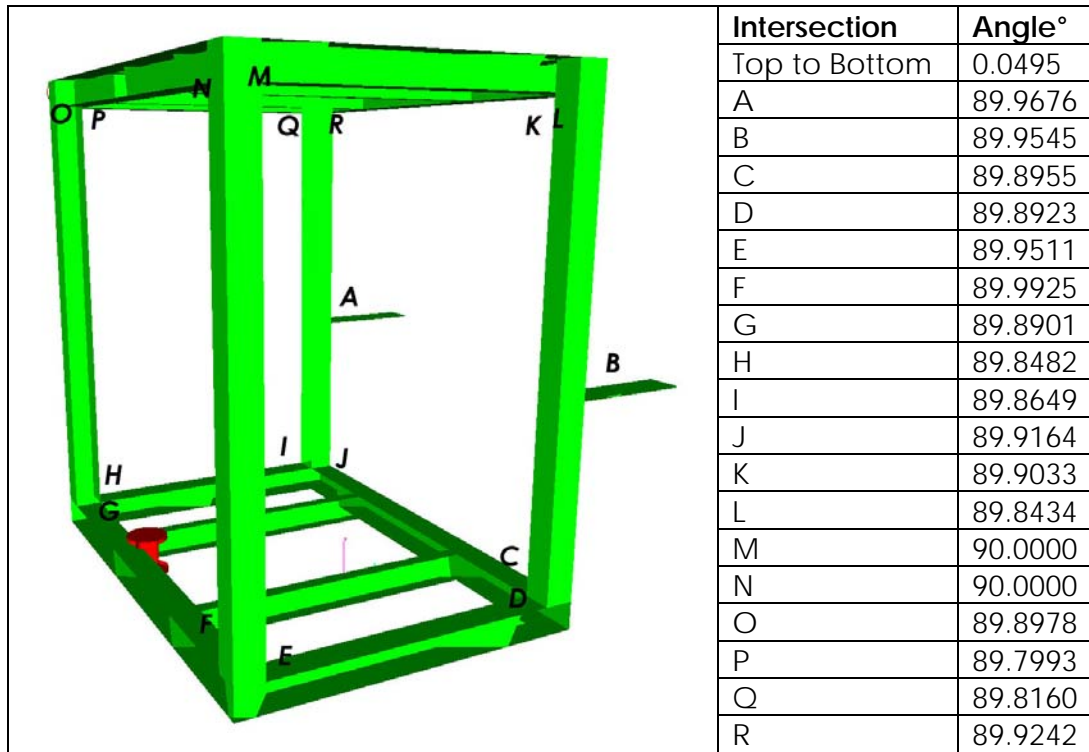
The data was used to create best fit planes, lines, circles and cylinders. These objects were used to calculate dimensions and angles of intersection where applicable.

The planes that were created and their respective RMS values are shown below.

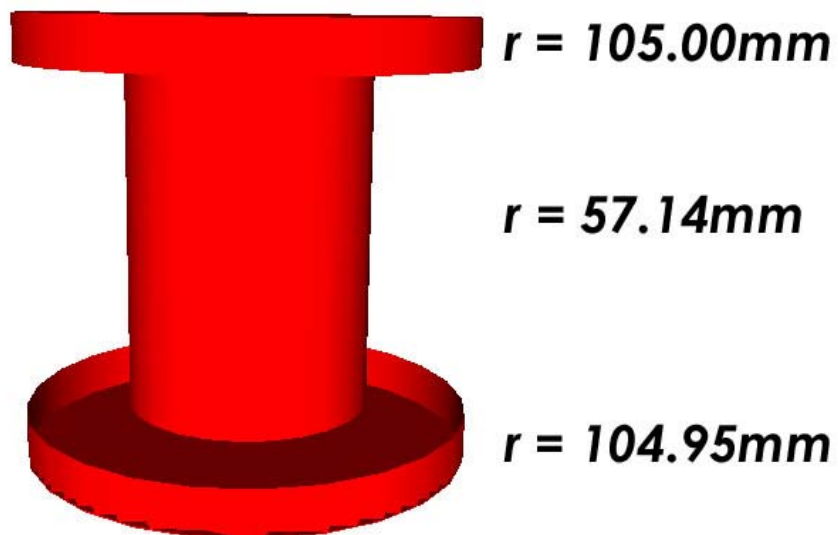


From this data a very distinctive pattern emerges. The planes that had welded components attached have a much higher RMS. Further investigation revealed that the majority of the deviation from Plane occurred in the areas where the welding occurred. Also, as expected, the individual RMS from opposing planes was almost the same.

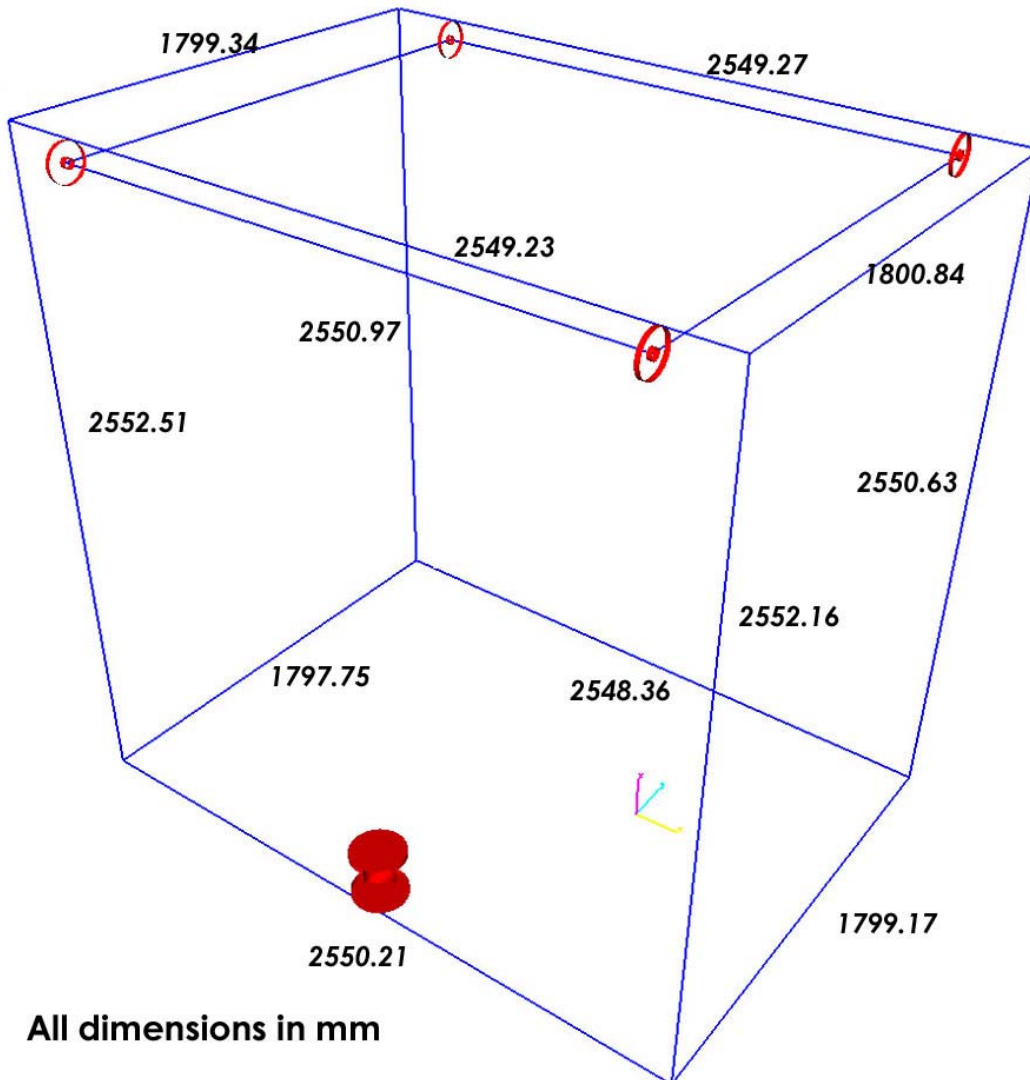
The planes were also used to calculate the angle between adjacent perpendicular planes. The results are shown below.



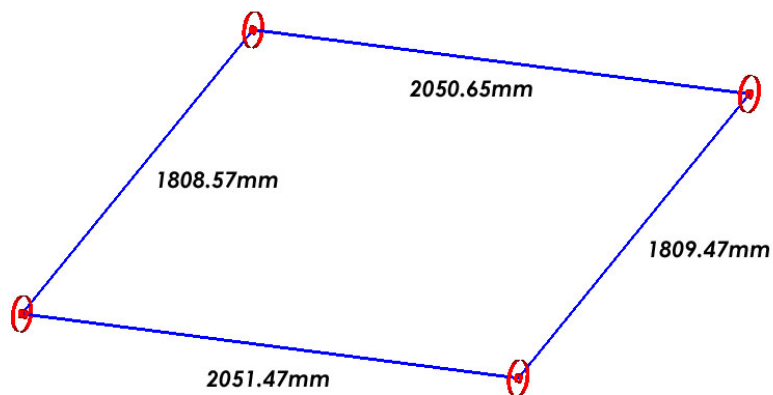
A cylindrical component was added to the scene to simulate a pipe in the field. The Object and the calculated radius values are shown in the image below.



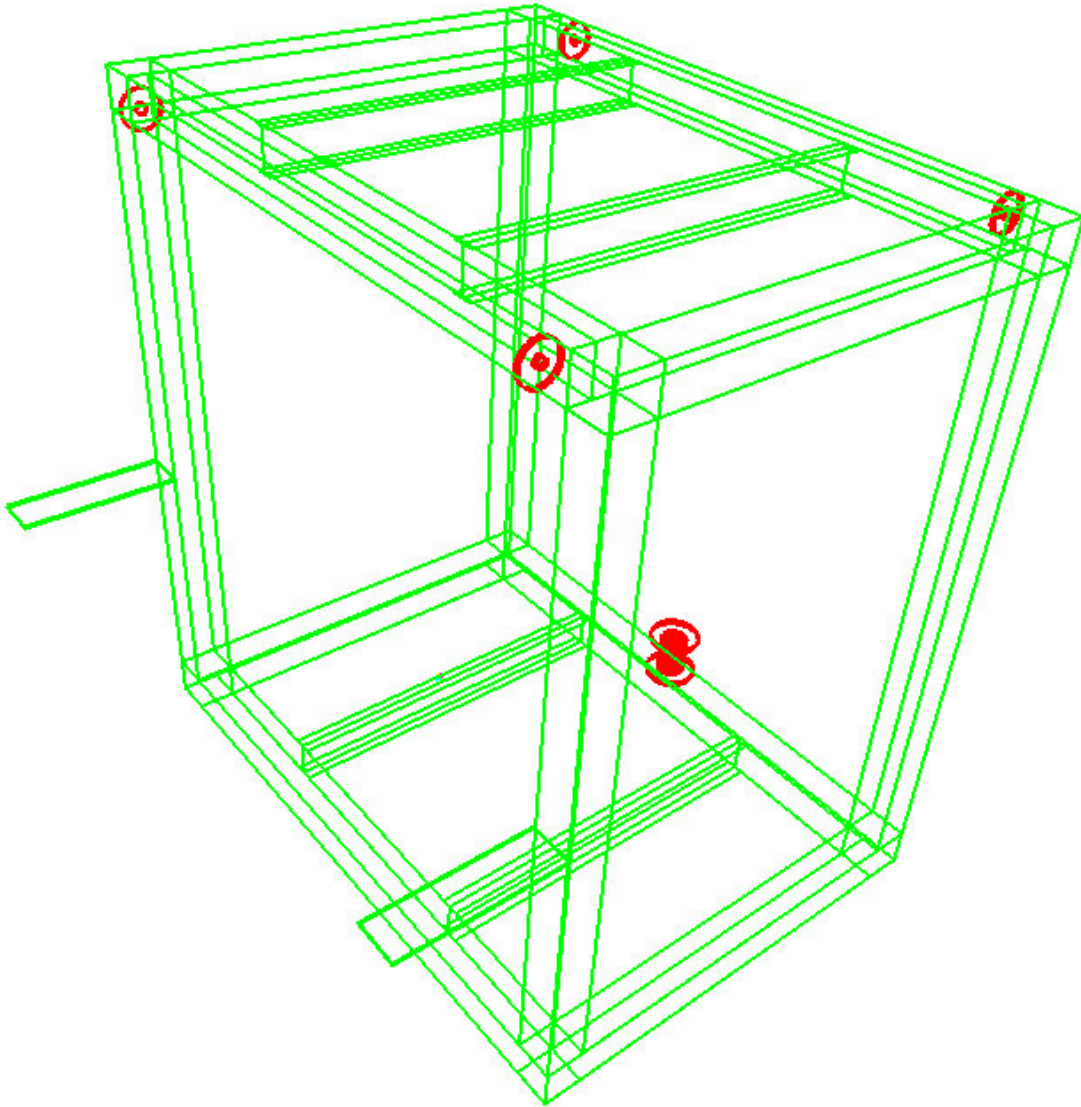
The planes were used to calculate the corner points of the object and the corresponding corner to corner dimension. These are shown in the image below.



The distance between circular lugs at the top of the piece were also computed. The distances are taken to the centerline of each lug. These are shown below.



The final model is shown in the image below.



Time Summary

| | |
|-----------------------|-------------------|
| Initial Investigation | 5 minutes |
| Targeting | 20 minutes |
| Photography | 5 minutes |
| Processing | 10 minutes |
| Data Analysis | 30 minutes |
| Total | 60 minutes |

Concluding Remarks

The measurement undertaken has shown that V-STARS with the E3X system can be a very powerful measurement tool. The results of the measurement undertaken were very accurate and more importantly were produced quickly.