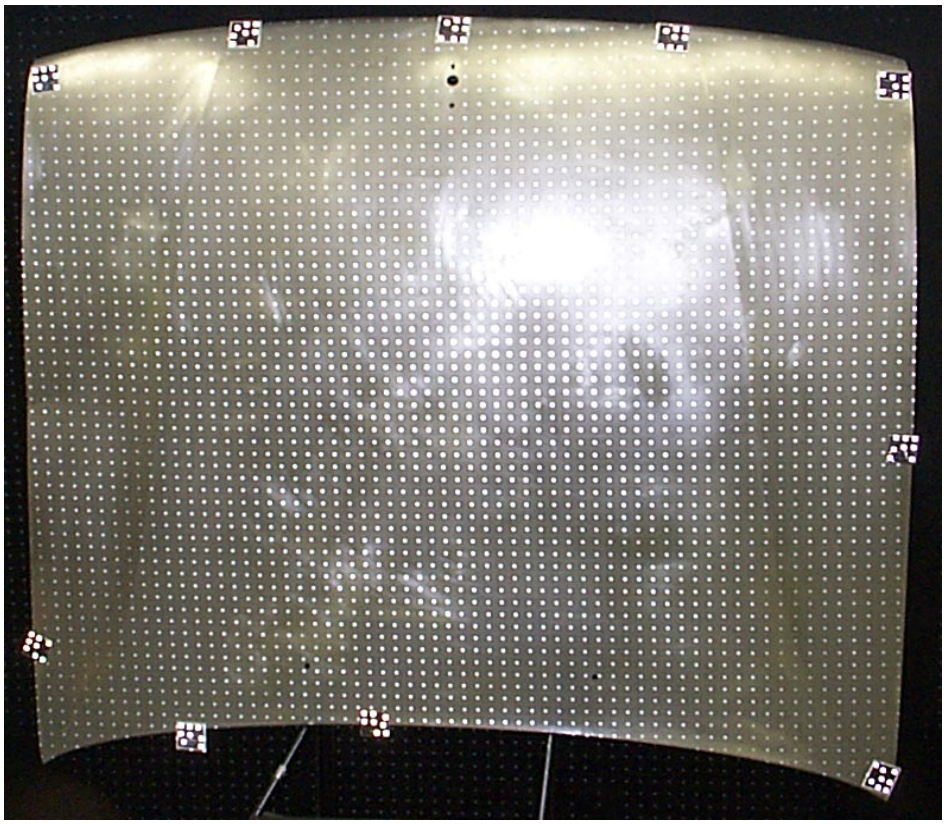
Application Note – Automotive Hood Measurement

Overview:

The following report summarizes the results of the targetless 3-D measurement of a car hood. The hood was photographed and measured using Geodetic Services, Inc's (GSI) and a single projector setup (targetless photogrammetric). Over 4,500 points were measured on the top surface of the hood to an accuracy of better than 0.001" (0.025mm)



Primary Measurement Requirements:

1. Measure surface of hood in a single projector set-up
2. Perform complete measurement in less than 10 minutes
3. No deformation of the hood as a result of measurement (**non-contact)**
4. Investigate damaged area on left hand side of the hood.

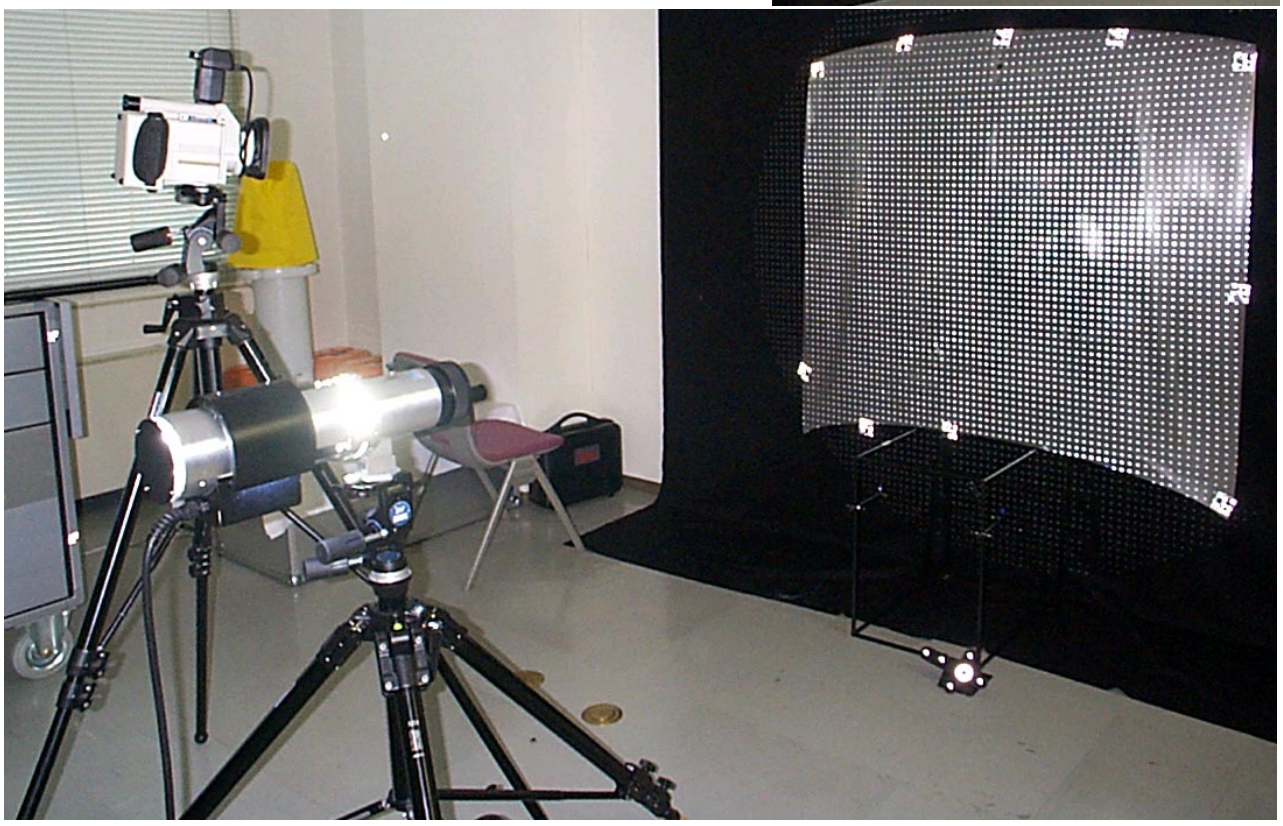
The measurement:

Targeting.

For this measurement very little stick-on targeting was needed. All of the targets required were generated via the use of the target projector.

The adjacent diagram shows some of the key targeting elements. To automate the measurement process it was necessary to add “coded” targets to the area around the hood. These targets are automatically detected and help the software determine the location and orientation of the camera at the time the photo was taken. They also help tie the entire object into a uniform coordinate system. The initial coordinates system and scale is determined via the AutoBar.

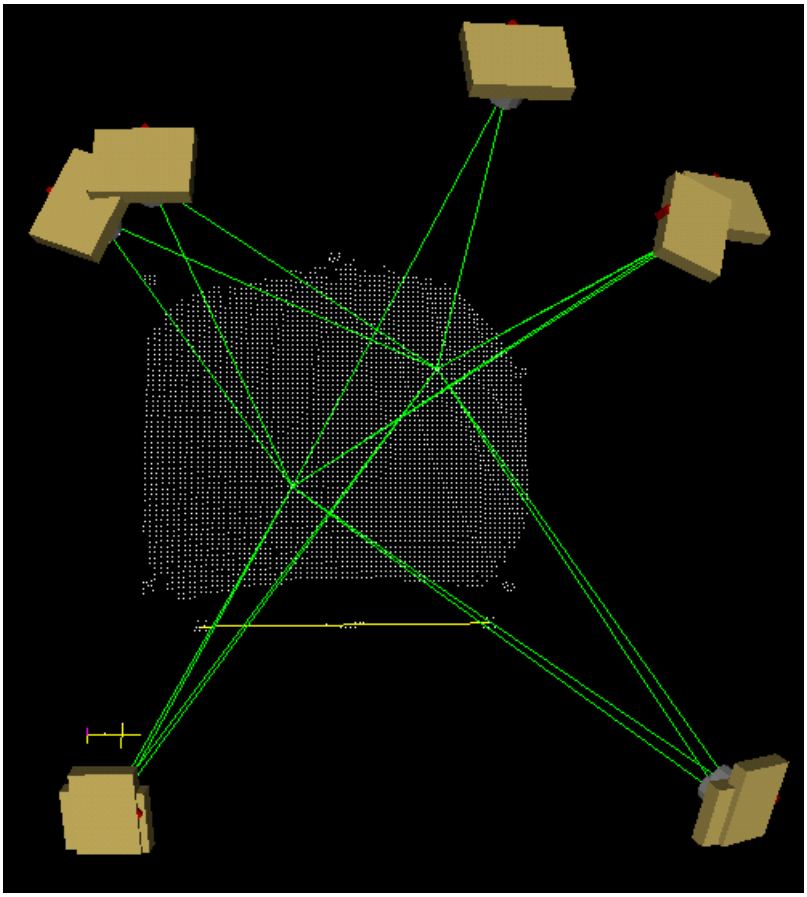
The system was setup and used as shown in the image below. The projector is placed so that its dots cover the area of interest on the object. Then, the single-camera is used to take pictures from two or more different locations around the object. Each time a picture is taken, the target projector also projects the pattern of high-contrast dots onto the surface.



Photography

The photography is carried out once the object targeting is completed. Put simply, the aim of the photography is to record each of the targeted points in as many images as possible from as wide a range of angles as possible.

The photography for the measurement was completed in only a few minutes. Camera station locations for the measurement are shown in the adjacent diagram. Also shown are sample intersection angles to points of interest.



A total of nine photographs were taken of the car hood in the first measurement. The number of photos taken depends on the complexity of the measurement and accuracy requirements. In this case the photography was rather straightforward.

Processing

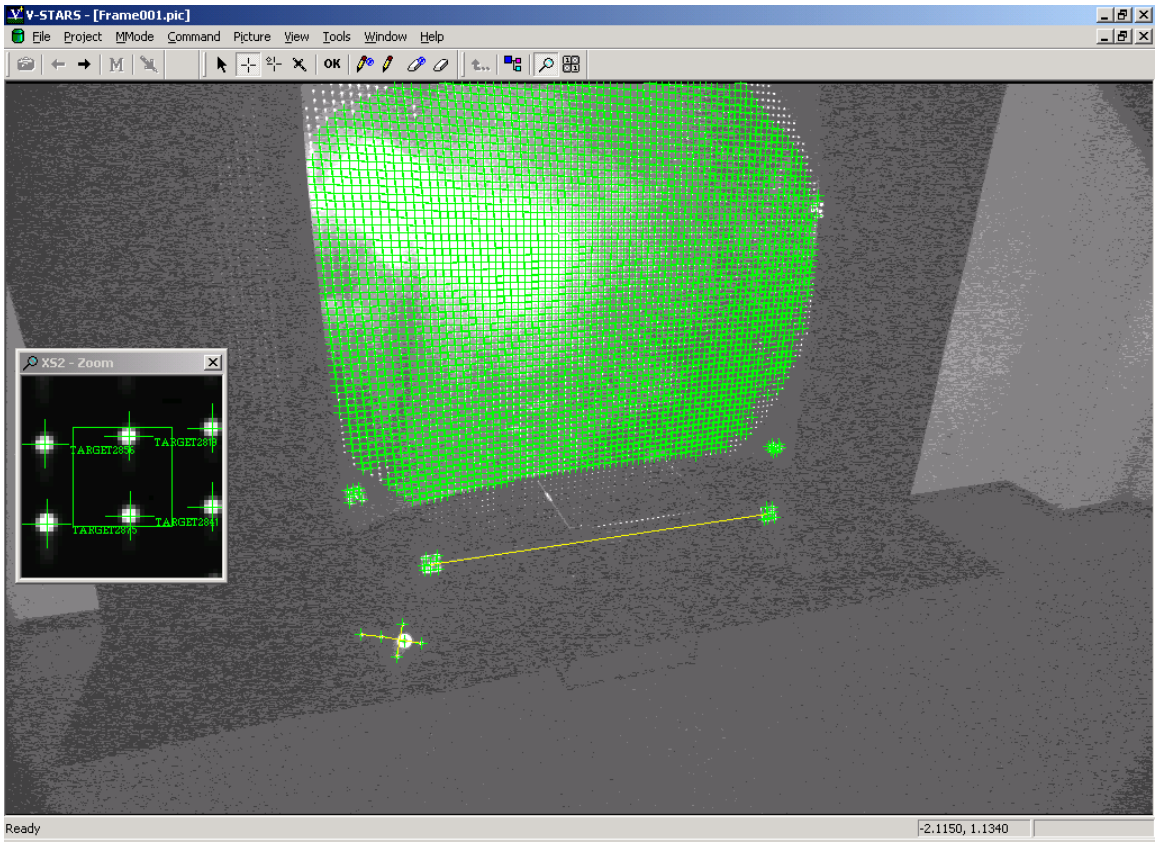
Once the photography has been completed the images are transferred to the system laptop. The images are stored on a PCMCIA hard drive and V-STARS accesses these images directly from the drive.

Almost all of the measurement process is automated. The images are processed and the coordinates extracted by the “AutoMeasure” command.

The AutoMeasure command will open each of the images, determine the camera location, find new target points and finally adjust all the measurements in the “Bundle Adjustment”. At the conclusion the user is left with the XYZ coordinates for all the target points in the network.

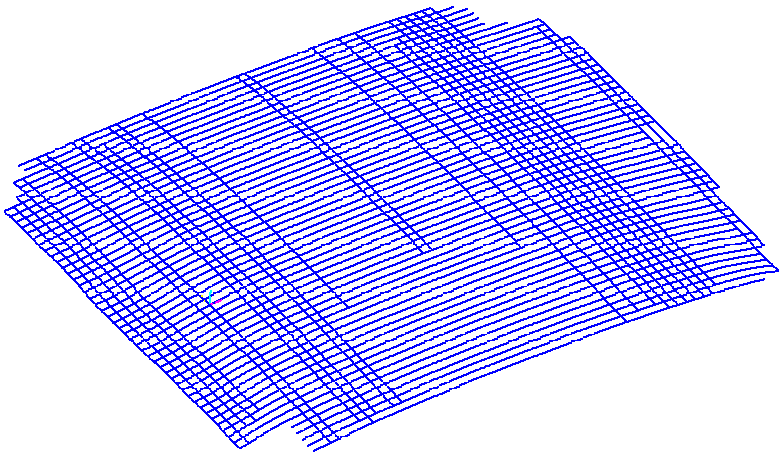
The AutoMeasure routine will assign random labels to the points it finds. These labels start with the key word “Target” followed by a number. If specific labelling is required the random labels can be easily changed to labels defined by the user. This is possible in both the picture view and the graphical 3D view. For this particular project it was not necessary to relabel the points.

Seen below is an image taken as part of the first hood measurement.



The crosses represent points that have been located in this particular image. Note that the image appears a little dark and difficult to see. This is intentional as the best photogrammetric measurements are made on images that have dark backgrounds and bright targets. Some of these targets are shown in the zoom window in the corner. If the scale bar is visible then a yellow line will be drawn between the two end points.

This point data is analysed using the V-STARS' Solids module, easily exported to almost any CAD platform or other analysis program. The Solids module features a number of very useful options. The user has the ability to compute best-fit planes, lines, circles, spheres, curves as well as measure to these objects. Some sample best-fit curves are shown adjacent. In this project the most likely form of analysis would be to the CAD file that defines the hood.



Results:

The following is a summary of the measurement statistics from the measurement of the hood when the projector was set up in one position.

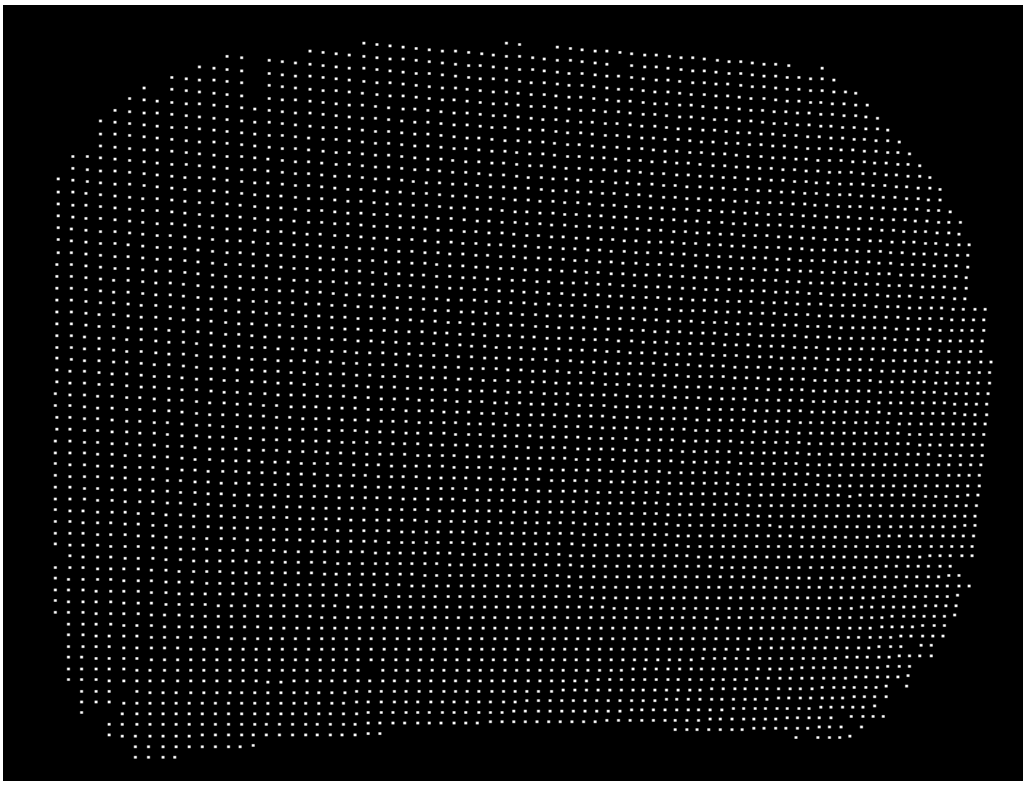
No of photos	9	
No of points	4576	
No of scales	1	
RMS(mm) X,Y,Z	X	0.022
	Y	0.027
	Z	0.014

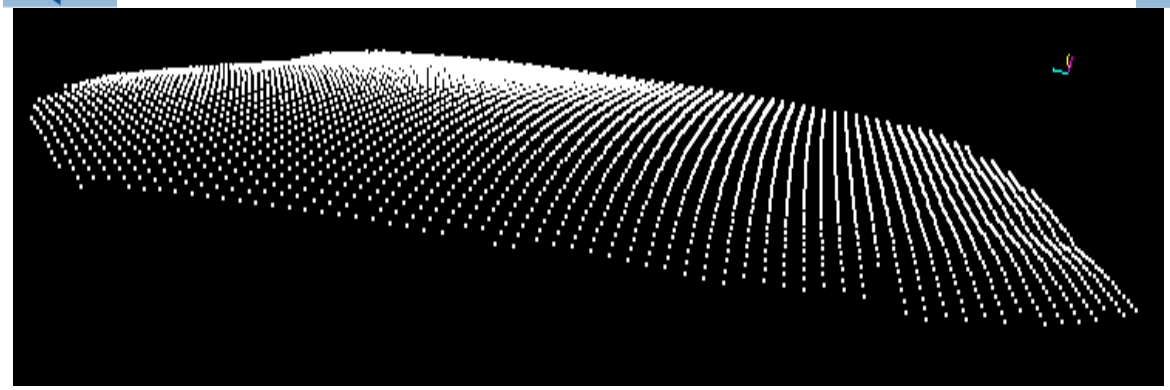
Time Summary

The following process times were necessary to complete the project.

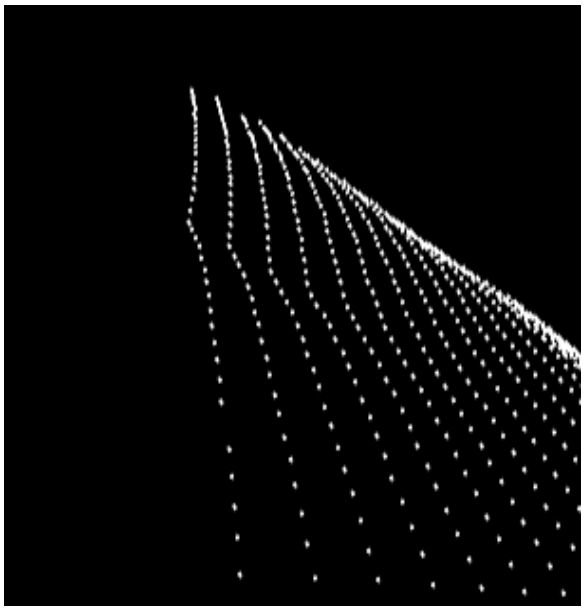
1) Target placement	1 minute
2) Photography	2 minutes
3) Processing	3 minutes
Total	**6 minutes**

Below are a number of images that show the cloud of points that represent the hood in various orientations.





The images above show a damaged area of the hood.



Concluding Remarks:

The hood measurement has shown can be an Antenna or any object where the surface is fragile , Hot , under vaccum chamber etc …the target projector can be a very powerful and versatile inspection tool. All of the measurement objectives outlined were easily met. The results of the measurement were very accurate and more importantly were produced quickly.

Here is a new and another clever tooling .

Measurement author : Guiseppe Ganci (GSI)
Projector designer : Nabil Romman (GMS)