Panel or part measurement - Individual / Assembled

V-STARS can be used to rapidly measure the surface or key characteristics of automotive panels. Typically it is important to verify the broad shape of the panel meets the specific surface tolerance outlined in the original design. Panels that are misshaped during pressing or deformed due to their addition to the body need to be identified early on in the manufacturing process to minimize their effect on production costs. Obviously if a panel problem can be identified quickly the resulting production losses can be minimized.

In other instances it may be necessary to locate the edge of part or perhaps even key holes in the panel. Once again V-STARS can be used to quickly and accurately measure these.

Finally V-STARS can be used to ascertain how individual panels behave once they are assembled or added to the main body. It is possible to have two parts that in their own right meet their manufacturing tolerance, but when combined together deform in an unpredictable manner. Once this assembled behavior is characterized it is possible to manufacture the parts so that they are incorrect as individual components but within tolerance when assembled.

BMW X5 master model used as a test bed for individual parts

Operator using hand-held probes to determine key hole location on Audi door

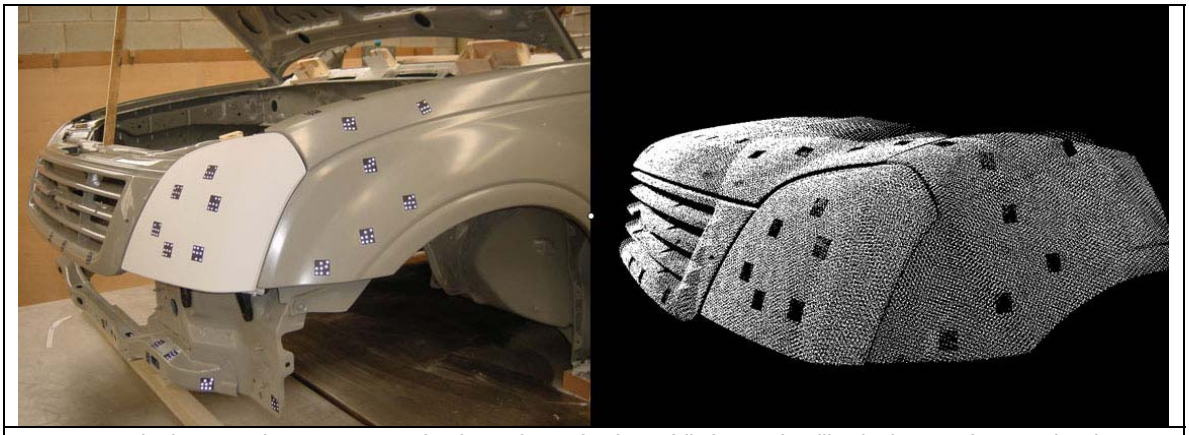
Surface Measurement - Component verification / Stamping and die measurements / Real time inspection

V-STARS can be used in conjunction with the target projection system known as PRO-SPOT. The PRO-SPOT is used to project up to 22,000 points onto the surface of the part or panel being measured. This allows the surface to be potentially inspected in seconds. Additionally, in most cases the surface can be measured in place or even at temperatures that would present problems for conventional measurement techniques.

As V-STARS is a portable system most, if not all, of the measurements can be carried out in-situ. This is a great advantage when the time taken to tear down and transport the item to a CMM is considered. Small or large changes can be made to dies and the resulting effects quantified almost immediately.

A common R&D task is to determine the surface of clay models that represent new designs. Design and style experts often manipulate the initial design by hand to produce more pleasing lines. These new lines can be quickly determined using PRO-SPOT to reverse engineer (RE) the surface.

V-STARS being used to measure and verify a car seat.

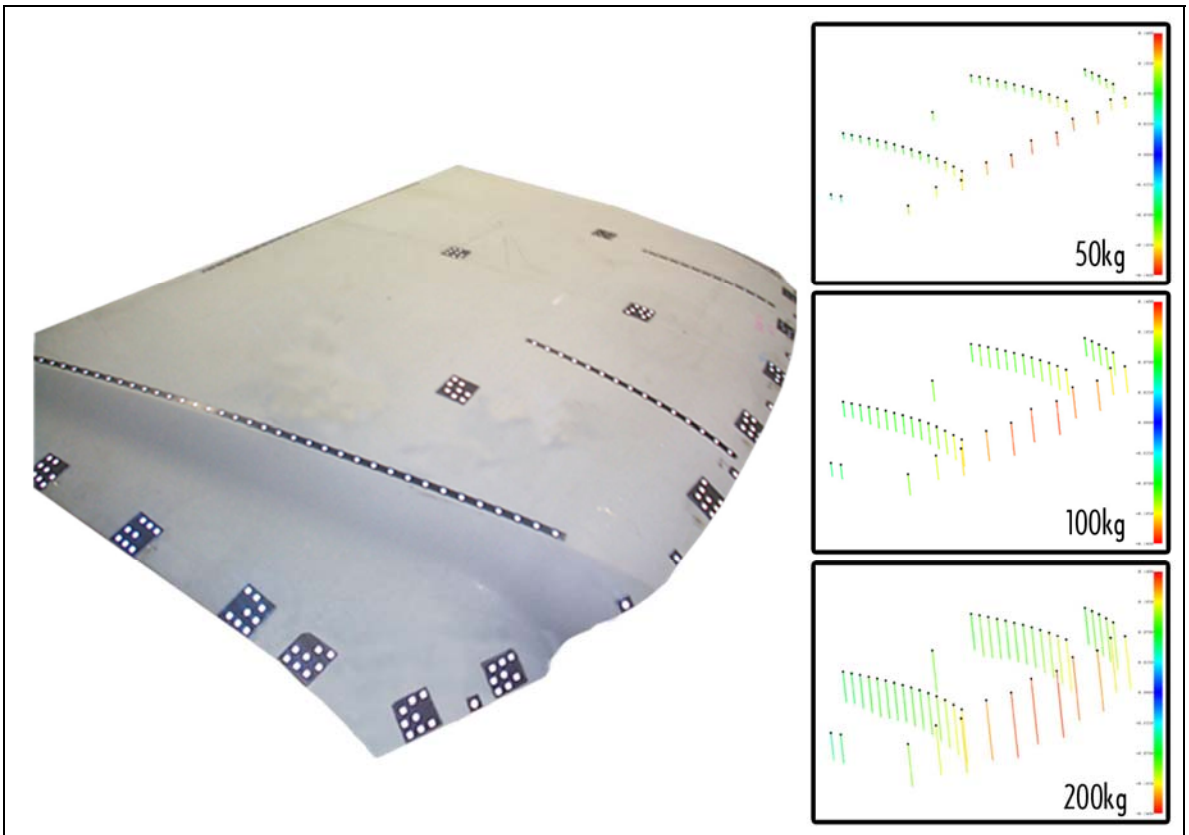


PRO-SPOT being used to measure the location of a head light and grill relative to the car body.

Deformation measurement - Deformation due to changes in position or attitude of components / Deformation due to load / Dynamic measurement

Through the use of cheap and disposable retro-reflective targets it is possible to carry our comprehensive deformation studies on any part or item. A small component or indeed the entire vehicle can be assessed. Studies that characterize how a body deforms as it is assembled can be very useful tools during the design of a new model. By quantifying how a body changes it is possible to build the effect of the deformation into the design. Similarly, studies can be conducted to determine the amount of deformation that is induced when a door is closed or perhaps when a vehicle is placed under load.

In a typical example one company carried out a comprehensive study of how welding stations affected the build of a car. Targets were placed on parts at the start of the production process and then measured at the end of each welding station. By the end of the build they were able to accurately assess the time at which parts of the built body were moving out of tolerance. Armed with this information they were able to modify the design to compensate accordingly.



Load testing of a bonnet at FORD to assess behavior under load

Repeatability check - Repeatability of individual components / Assembly tool repeatability studies

The key to any quality manufacturing is repeatability. In automotive applications, consistency of build is paramount to producing a car that will pass quality standards. V-STARS incorporates an Automated Repeatability Module known simply as ARM. This module is used to quantify how repeatable a particular manufacturing process is. For example, consider the case where a bumper is being attached to the vehicle. Targets are placed on the bumper and in the vicinity of the area where the bumper will be attached. As a first step, the bumper will be measured on it own to quantify its shape without any the influence of the actual mounting. The bumper is then attached and measured using V-STARS. The bumper is then removed, reattached and then re-measured. This process continues until a suitable sample size has been collected. Once the data collection is complete, the ARM module is used to automate the measurement reductions and calculate statistic data for the process. The user is also given graphical representations of the deviations from assembly to assembly.

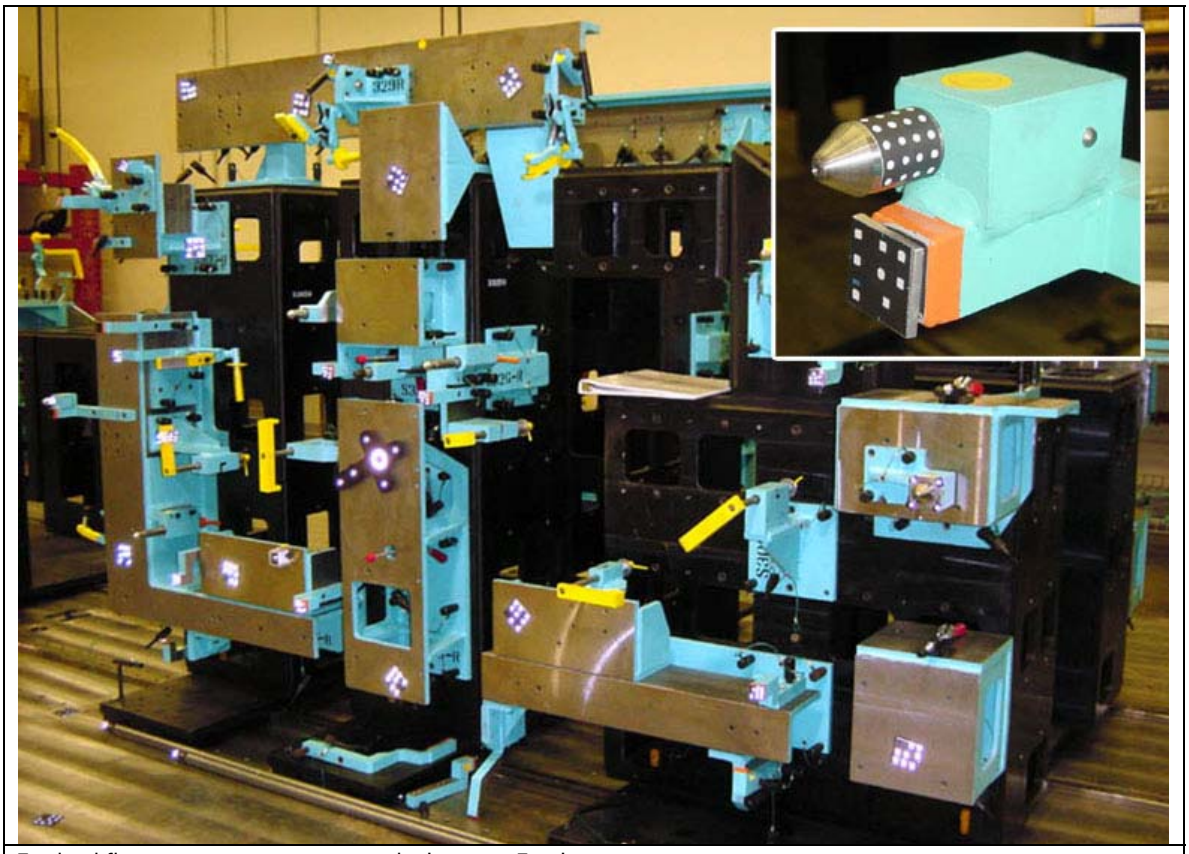
The data produced my ARM can be used to verify that the repeatability of the process is being met.

Typical study to quantify repeatability of door closure on a BMW

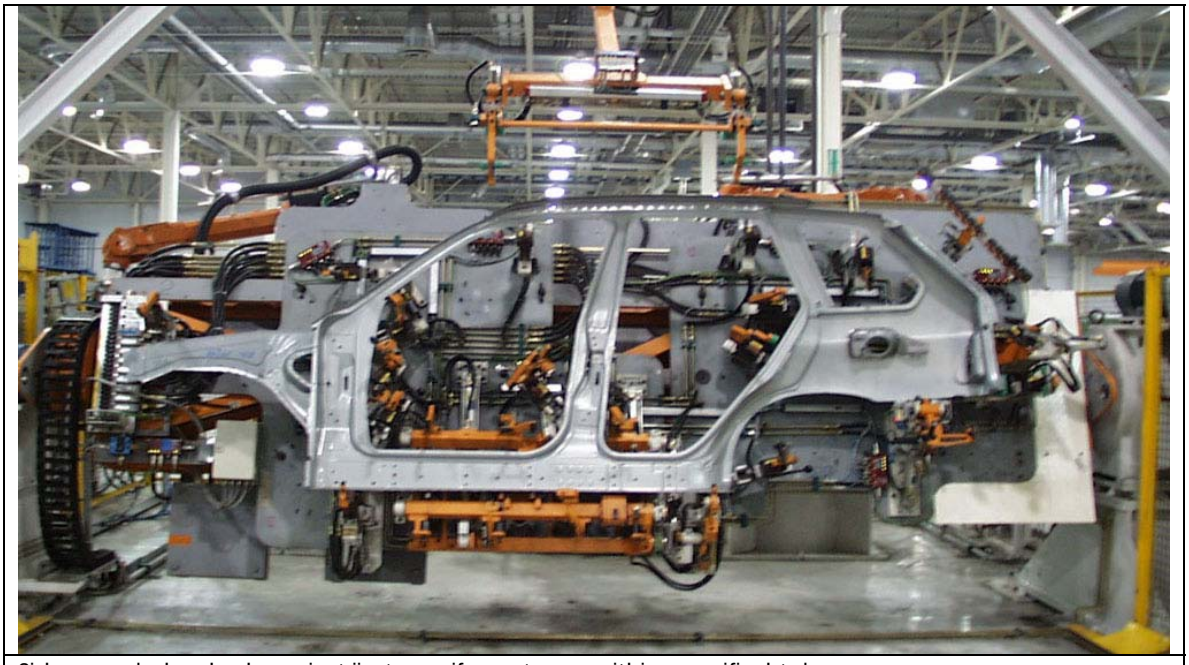
Jig Verification - Periodic inspection of jigs / Verification after initial build

Assembly jigs and tools are the cornerstone of automotive assembly. Jigs that are inaccurate or poorly set up lead to lost production time and result in diminished quality. One of the more common V-STARS applications in Automotive is the set up and verification of production tooling and jigs. Typically jigs are built by a third party company and then delivered to the manufacturer. Upon delivery the jig is incorporated into the line and measured to verify that is meets the original design specification. Once measured it may be necessary to adjust some of the pad and pin locations. As V-STARS produces results very quickly the adjustments can be carried out and the items re-measured.

On the odd occasion it may be necessary to rapidly re-verify the jig. Typically these occasions are the result of some sort of calamity on the line. Once again the speed and portability of V-STARS allows the re-verification to take place with very little impact on the production. In most cases the measurement can be carried out during lunch or one of the scheduled production breaks.



Typical fixture measurement carried out at Ford



Side panel checked against jig to verify parts are within specified tolerance

Component Alignment - Alignment of key components and hinge lines / Alignment of manufactured components to body

The alignment of key components such as doors, hoods and boots is very important to the overall quality and finish of a car. Doors that don't close properly or gaps between panels are unsightly and lead to a perception of poor quality.

V-STARS can be a very powerful tool used to help track and eliminate these sorts of problems. In one instance a manufacturer found that the doors of the vehicle were distorting the frame. Though V-STARS analysis they were able to quantify the distortion and manufacture this into the body. When the doors were added they distorted the body back into the correct shape.

Shape analysis - Measurement of parts to verify shape fit to CAD surface mode / Verification of shape under load

Combining a collection of parts together to form a car is a complex process. As mentioned in previous examples often the process of assembly itself leads to perfectly good parts not going together as designed. The key to success is the ability to accurately quantify where problems are occurring. This is often problematic as the particular area may have parts from dozens of suppliers. This is further complicated by the fact that these parts are being fit or welded together. Without accurate measurements isolating the one or more parts that causes the problem can be difficult or near impossible.

In one example a company had a significant problem with a rear tailgate closing correctly. After a series of V-STARS measurements the problem was traced back to the manufacturer of the glass panel.

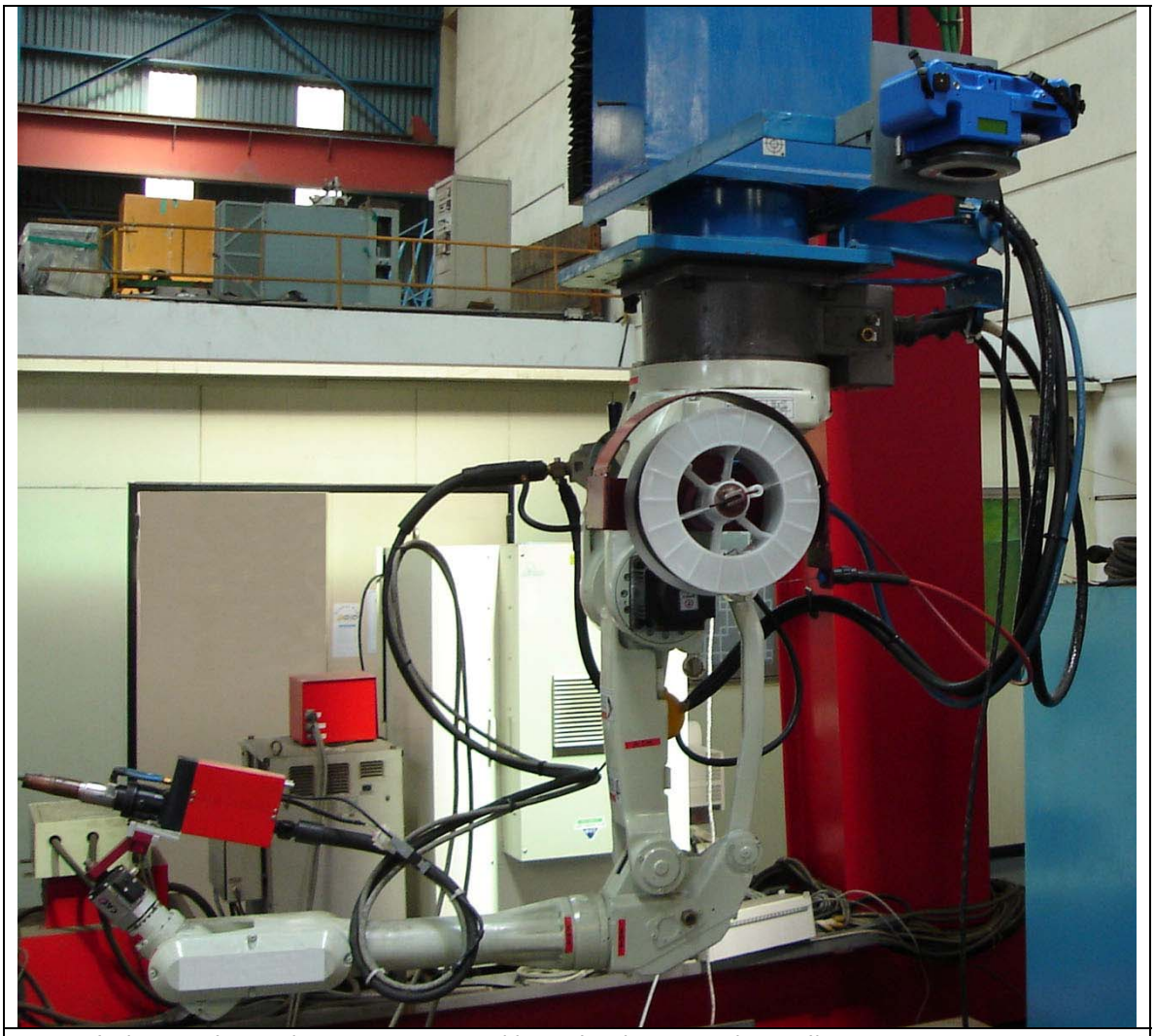
Typical surface measurement to verify door position

Robotic adjustments - Adjustment of robotic equipment

When a new production line is commissioned typically the tooling and robots are assembled off-site and then transported to the plant once the line is ready to be installed. As part of the build process the robots are positioned and programmed. In a complex cell as many as four robots may be working in unison during a build. As one would expect the alignment of these robots is critical. Poor alignment will result in lengthy re-programming. The ideal situation is to transport the tools and robots to the plant and then to accurately re-position them.

V-STARS has been used extensively to solve this problem. Once the station build is complete and the robots are in place individual targets are place on all the jigs and robots. These targets are then measured. Once transported, the tools and robots are placed into their approximate locations. V-STARS is then used to measure these positions and calculate how much adjustment is needed to get each piece into the correct position. After a few iterations the robots and tools can be positioned into he correct location.

In other instances, the ability of V-STARS to command the INCA camera remotely has been utilized to create a robotic work cell.



INCA3 being used to assist to accurate position robot in external coordinate system

Production line measurements - Dimensional checks of cars during build cycle

The speed at which a production line moves means that often there is no time to measure cars on the actual line. Lines are constantly moving and systems that rely on object stability can't be used. V-STARS is impervious to the effects of movement and vibration and hence is the ideal tool for production line measurement.

In one study carried out by BMW in South Carolina, a five minute window between assembly stations was used to measure the location of key points on the undercarriage of the body. The car was constantly moving during the measurement but the staff were still able to produce the required data in the time frame.