Use of an Optical CMM and Analysis Tools

A detailed review of capabilities, and features.

Tools – Zeiss Comet, Colin3D & Calypso

Optical CMM's are a cutting edge inspection tool that provide the greatest amount of data in the shortest amount of time. They are better than a bridge CMM in many areas, as well as provide the same measurement capabilities as a bridge CMM.

Optical Computer Measuring Machine, or Optical CMM, is a device that measures the geometry of physical objects by sensing discrete points on the surface of the object. Various types of tools are used in CMMs, including mechanical, optical, laser, and white light.

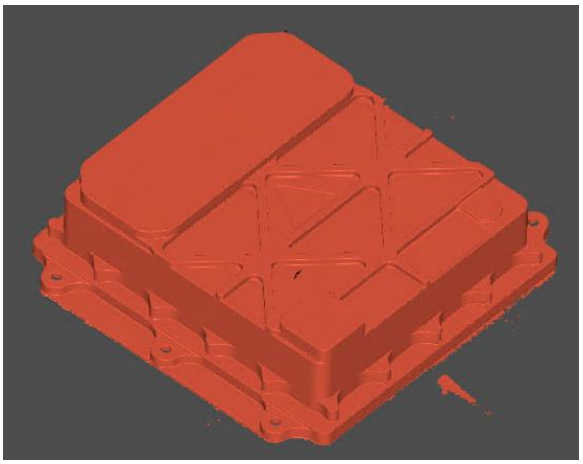

Figure 1-Mesh

Optical CMM's such as the Zeiss Comet use a fringe projection to pick up discrete points of measurement on the surface of an object. This tool, along with the measurement software and rotary table create a full three-dimensional point surface scan of the object. In the software, Colin3D, the point cloud is optimized to remove outlier data and converted to a mesh. (Figure 1)

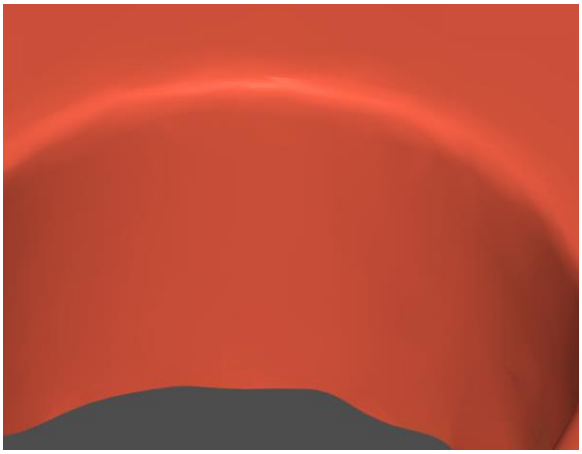

Figure 2 - Close up on mounting hole

Once a high precision mesh has been generated. (Figure 2) the mesh is aligned with the solid model data. At this point the mesh is fit to the model and the analysis can begin. This is the point which the analysis can be split down two paths. First path is colin3D heat map, where a comparison between the model and the physical part occurs with a specific tolerance set. For example, a model with a +/- 0.005 inch requirement will be represented under a Go/No Go heat map. (Figure 3)

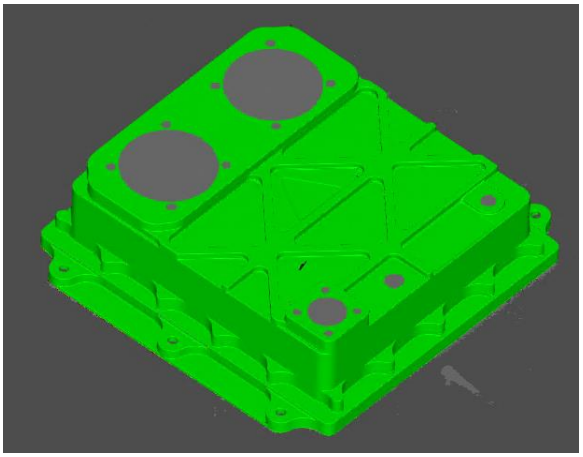

Figure 3-Go/No Go Inspection +/-0.005 Inches

The heat map solution provided more information than a traditional bridge CMM. A key feature of the heat map is adjusting the tolerance to show a smooth gradient from -0.005 to +0.005. The part in Figure 3 and Figure 4 are the same part with the same scan. The change is showing the gradient for the data collected. (Figure 4)

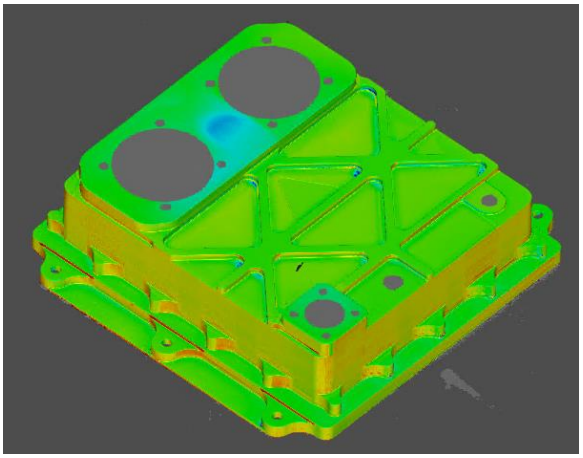

Figure 4-Gradient Review on +/-0.005 Inches

We know this part is a good part because it passed the Go/No Go test with the traffic light analysis set at the +/-0.005 inches the drawing calls out. However, using the gradient, we are able to understand more about the parts behavior and see areas of potential concern. I.E. areas that are closer to the upper or lower end of the tolerance limit. This review helps keep an eye on tool wear or process changes.

At this point the analysis can go a different direction. Use of the CMM for distinct measurements occurs within a software called Calypso. This software works in a similar way to the Colin3D software. Whereby the mesh is aligned with the solid model. Features are selected on the model and a measurement plan is generated based on the desired inspection criteria. Just like the Bridge CMM, the software being used is what allows the user to pull a specific measurement. The large database of measurement points is stored and referenced when looking to call out specific dimensions.

At the core, both methods produce the same result. Do the parts meet the specification? It is a matter of analysis and long running data, as well as a comparison to the drawing. The heat map produces a highly accurate and quick analysis of the part. The mesh for this part shown in figures one through four contain over one million measurement points in an approximately 7-inch by 7-inch object. At a more micro scale, that results in having large amounts of data collected for each feature in the realm of fifty thousand measurement points. (Figure 5) What this means is a data set already exists for the feature that is called out on the drawing. The small feature shown in figure 5 is a good example, it contains the data from the scan already. This data is called up and used in the Calypso software to generate a measurement plan.

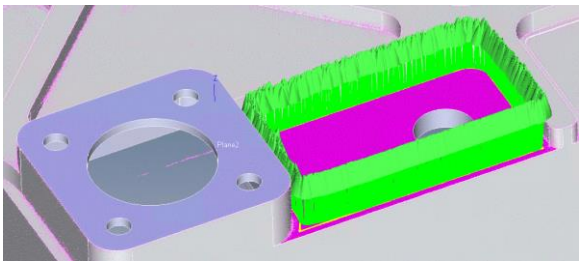

Figure 5-Measurement plan option

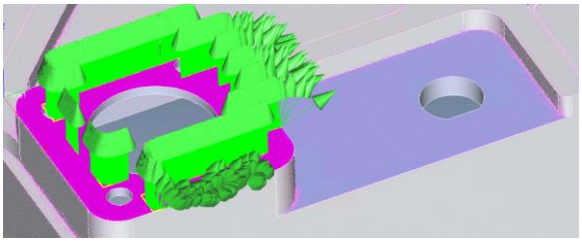

Figure 6-Additional measurement plan option

Seen in figure 5 and 6 is a representation of a measurement plan. The options and design of the measurement plan can be as simple as a traditional Bridge CMM with a single point measurement or planed surface path. Additionally, the measurement plan can be as complex as the programmer wants based on the data needed to review the part.

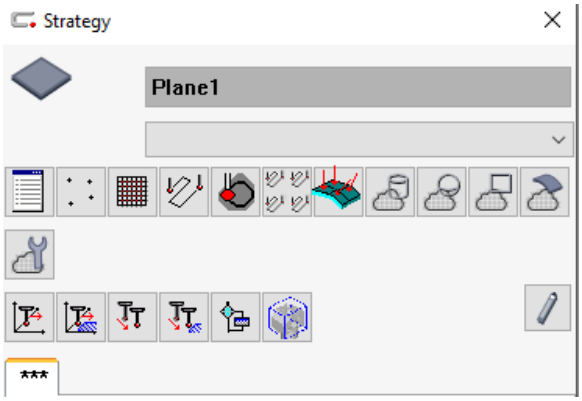

Figure 7-Options for the measurement plan

The goal of this tool is to use the large amount of data in the most effective way for the analysis that is needed. That may be a detailed position measurement using the Calypso software to generate specific dimensional review, or using the data at a global level to review 100% of the model to see if the object meets specifications called out by the drawings. The detailed measurement output generates a report seen in figure 8, generated from the features selected and the characteristic used to generate the measurement plan seen in figure 7.

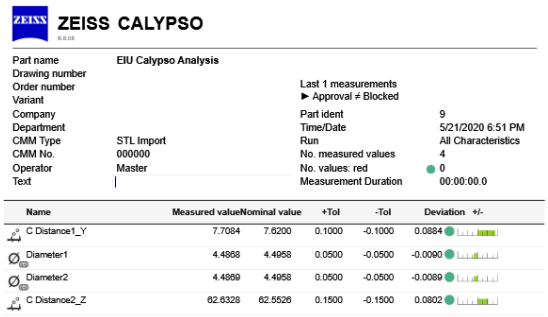

Figure 8-Report Out

The benefits of an Optical CMM are abundantly clear when looking at efficiency in inspection time. A full scan and analysis of a part takes between One to Five minutes and provides much greater detail than can be generated in the same time with a Bridge CMM. The inspection is faster, provides more data, and can present a clear global picture for the object under inspection.

The Optical CMM and Calypso software is not limited by any optical inspection capabilities relative to a Bridge CMM. If a point analysis is needed measuring the distance between features such as distance, flatness, or other specific drawing call outs; the One-Million point data set and Calypso software allows us to inspect specific features and generate the report out. (Figure 8)

What is measured by a Bridge CMM can be equally measured by the Optical CMM. The decision on inspection type and analysis drives the time associated with the inspection. If an FAI can be done using a heat map and Go / No Go analysis, the inspection time, and in turn the cost, can be greatly reduced. If the FAI needs specific dimensional call outs, the Optical CMM can provide the same capabilities that a Bridge CMM provides for inspection.