The *Independent* Solution Provider for Smart Digital Transformation

Predictive Assembly in ATS CM4D

ATS CM4D allows you to predict how your manufactured components will fit together with the use of 3-2-1 Alignments, Stacked Alignments and Animated Alignments.

Alignments in ATS CM4D

ATS CM4D can predict how parts will assemble in the real world by using meaurement data to simulate Iterative 3-2-1 Alignments virtually.

You can see how parts will fit together (predictive join) and make adjustments as needed (virtual shims) well before the parts are physically assembled.

While there are similar products that are primarily based on transformations or that do a re-alignment by computing a new reference frame (best fit), ATS CM4D goes through the simulation of an iterative 3-2-1 Alignment and allows you to make any adjustments that are necessary.

Why Use Alignment?

▶ No need to write individual inspection routines for each sub datum scheme.

▶ Predict how parts will assemble well before actually assembling them.

▶ Investigate potential process adjustments to see the effect without actually adjusting the process.

▶ Get a visual of build issues as they happen.

Not Aligned

Individually, both parts are out of tolerance.

Aligned

If parts were assembled, they would line up quite well.

Aligned with Offset *(-1.3 on Y Axis)*

A minor grid adjustment on 1 part –successful assembly.

www.ats-global.com

The Independent Solution Provider for Smart Digital Transformation

Alignment Used by Turkish Automotive Manufacturer

At an automotive manufacturing plant in Turkey, CM4D Alignments are used by Body Shop, R&D, and Metrology engineers to analyse the measurement data for parts that are in production. They don't have to wait until the product is finished before they can analyse and make adjustments as needed in order to achieve an optimal result for the final assembly.

Engineers can take the measurement data coming in from parts in production, perform an alignment on those parts in CM4D, and predict the result before those parts are physically assembled. Being able to predict any build issues early on allows them to make adjustments to the parts in production, preventing expensive rework after assembly.

This automotive manufacturer reported that without CM4D's Alignment functionality, they could have 4000-5000 vehicles built before an issue was noticed. With CM4D, potential build issues can be detected and resolved before the parts even reach assembly.

Stacked Alignments

Using alignment to predict true assembly conditions on two parts virtually is valuable information, but what happens when additional parts are added on? Will the deviations found on the first two parts, although within an acceptable tolerance, cause fit issues further down the assembly line?

ATS CM4D can create Stacked Alignments by using the result of one Alignment as the reference datum for the next Alignment to predict the result of an assembly of multiple components, or parts. There is no set limit to the number alignments that can be stacked, so Stacked Alignments can be done even on complex assemblies with a large number of components.

For example, if a plant is making Access Panel Assemblies, several components are involved:

1. **Frame** with the Hinge mounting holes and Latch pin.
2. **Two Hinges** with holes that attach to the Frame and the Door.
1. **Door** with the holes where it attaches to the Hinges and a hole where it attaches to the pin on the Latch.

With the Stacked Alignment functionality, ATS CM4D can predict how the Door will attach to the frame based on the measurement data from the four individual components. The Frame has holes on the left side for the two Hinge attachments, and one point on the right for the Latch pin to connect with the door. If there is any deviation in these points on the frame, the attachment of the Latch is going to be affected. Likewise, any deviation in the Hinge holes will affect how the Door attaches to the Hinges, and so on until the last piece is added to the assembly. These deviations can all add up to an access panel that cannot be assembled properly.

Access Panel Assembly

Deviation in Frame...
Deviation in Hinges...
Deviation in Door...
Stacks into Deviation in Latch.

DX = +0.93
DY = -5.34

**The *Independent* Solution Provider for Smart Digital Transformation**
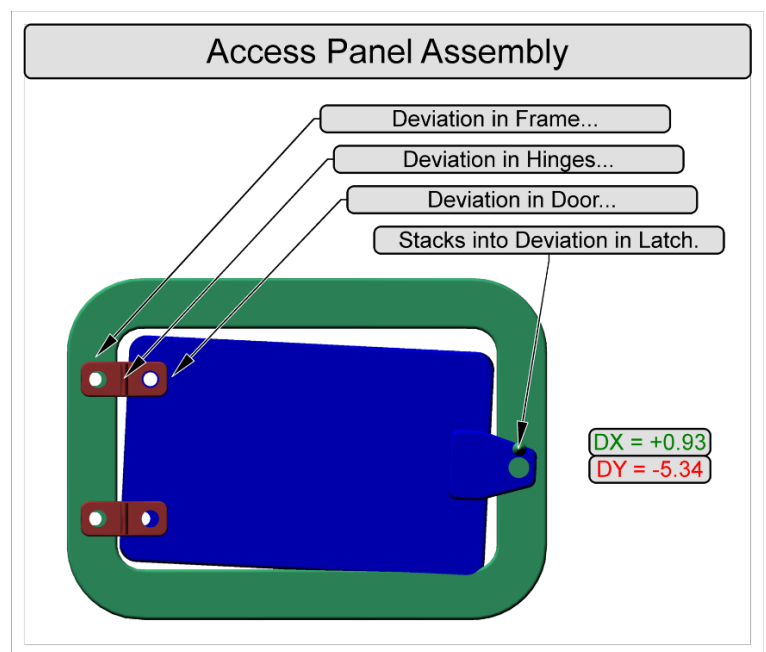
Animated Alignment

Once you have a Stacked Alignment, the 3D part models can be animated to show you how the parts are going to assemble. CM4D animates the 3D images to show a comparison of the Nominal position of the parts and a representation of the measured position of the parts. These animations can be output from CM4D as an animated GIF that can be viewed with reports in CM4D Web, attached to Email notifications for EventSmith alarms, or used for other purposes.
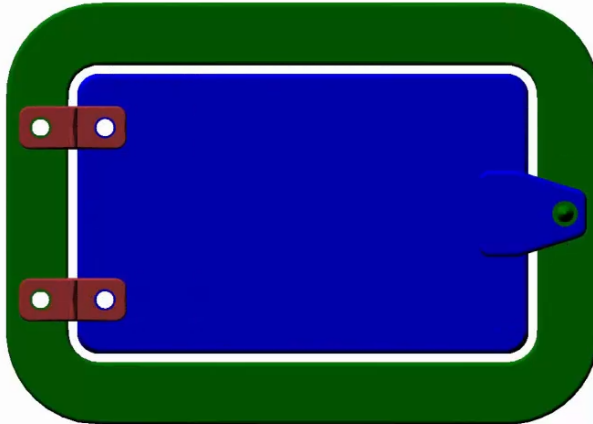
Nominal Position   **Actual Position from Stacked Alignment Result**
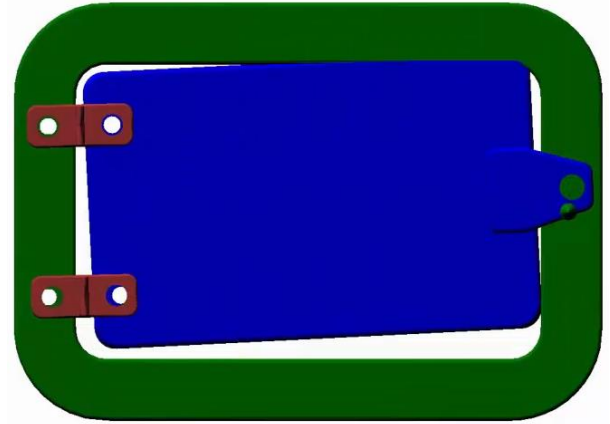
The animation is based on a single sample of the components, but if you wanted to show the process you could use the mean of multiple samples instead.

The Turkish automotive manufacturer mentioned earlier has implemented Animated Alignment by displaying the animated GIF on screens along the production line so they can see how they are doing while they are building vehicles. This allows shop floor operators to see if the parts are starting to show issues that will affect the entire assembly. By giving them real-time visual cues as to where the issues are, the operators can see what adjustments can be made to the parts in production in order for the final assembly will be successful.

For example, if CM4D predicts that the Door will shift up and to the right, operators can check to see what could be causing the offset. The issue may not be the Door itself, but perhaps with the holes on the Frame or on the Hinges. Identifying this problem before the Door is physically attached to the Frame and Hinges allows operators to resolve the issue in the Frame or Hinge production line rather than reworking the entire Access Panel Assembly later on.

Who Can Benefit from Alignment?

- ▶ Measurement Management Departments
- ▶ Metrology Departments
    - ▶ Press Department
    - ▶ Body Shop
    - ▶ Assembly Shop
    - ▶ Measurement Centre – Main Measurement Laboratory: look at subsets of data from the other three departments to watch the averages
- ▶ Assembly Line Operators: look at the animation on the shop floor, make adjustments in line
- ▶ Engineers: Analyse data in CM4D
    - ▶ Body Shop Engineers
    - ▶ R&D Engineers
    - ▶ Metrology Engineers