

Cirrus Aircraft Utilizes FARO Laser Tracker for Robot Calibration

How Cirrus Aircraft uses Laser Tracker Technology to validate the setup of the robot to ensure its true position accuracy, reduce the quantity and complexity of required fixtures, and cut tooling costs by 60%.



"Though the robot calibration is a unique application, Cirrus has also utilized the Tracker with other large scale needs such as assembly and bond fixture setup, component inspections, and even entire aircraft inspections. The FARO Laser Tracker has and will continue to be a valuable tool in Cirrus Aircraft's arsenal of success, both now and into the future."

FARO[®]

With more than 25 years of dedication, the name Cirrus is associated with performance, safety, comfort, and innovation. Since 1984, Cirrus Aircraft (www.cirrusaircraft.com) has been committed to the future of aviation through its focus on safety, innovation, and improving the overall flying experience.

Cirrus produces the world's top two best-selling piston-engine general aviation aircraft, the Cirrus SR 22 and SR22T, with an unmatched integrity in design, quality, and engineering. Using an analytical approach, Cirrus embraces industry best-practices when it comes to analysis and modeling. Using this methodology, they are able to understand the structural characteristics of materials and components and then build a computer model. This process begins by predicting the characteristics of composite structures, using analysis, and then validating the collected data with the computer models. This process is an expensive one – but demonstrates Cirrus' commitment to quality and safety.

This analytic approach continues with the development of the Cirrus Vision SF50, a single-engine, low-wing, Personal Jet. The Vision SF50 is designed to fill a significant niche between piston aircraft and Light Business Jets. Like every Cirrus aircraft, the Vision will also incorporate the Cirrus Airframe Parachute System (CAPS) which can safely lower the entire plane to the ground in case of an emergency.

Challenge

To eliminate the need for racks of hard-tooling for the new Vision SF50 Jet project, Cirrus significantly invested in converting a 6-axis manufacturing robot into a CNC milling machine. This robot, a KUKA KR-100 HA L80 (High Accuracy), uses a vision camera to locate and align to a part and then drill any required holes and trim off any excess flashing to define final part shape.

The KUKA has a working radius of 9-feet and is mounted on a 40-foot linear axis rail, just long enough to accommodate the 38-foot long wing of the SF50 Vision. The fuselage cabin structure is 5.1 feet wide, 4.1 feet tall, and 30.9 feet long. Smaller parts, parts as small as 6-inches x 4-inches x 2-inches, can also be cut by the robot while being held in place by a vacuum table. Larger parts, however, utilize dedicated holding fixtures.



Cirrus needed a solution to validate the setup of the robot and to ensure its true position accuracy. They were seeking technology that would allow the real-time validation of trim paths and drill accuracies without potentially inducing defects to a physical part through trial and error. Accuracy was the number one priority.

Solution

Cirrus uses a 12-foot FaroArm with a Laser Line Probe along with a bridge-style fixed CMM for many projects. However, due to the size and accuracy demands of this project, neither provided the ideal solution for mapping the KUKA robot.

To properly map the robot for their trim and drill needs, Cirrus integrated a FARO Laser Tracker into their processes. The Laser Tracker has a large working volume (230-foot diameter) and automatic SMR (Spherically Mounted Retroreflectors) tracking — making it the ideal tool for mapping the robot. The large working volume alleviates the need to leapfrog (Move Device Position) a smaller volume measurement arm, which can quickly



degrade the overall accuracy below the acceptable limits after several iterations. Being able to measure any point in the robot cell with the Tracker has proven to be critical to the process.

During setup and mapping, the Tracker was dedicated full time, for eight weeks, to the robot cell. Using FARO's SDK (Software Developers Kit), Cirrus was able to have the robot program tell the Tracker when it was in position and command the Tracker to take a measurement. The true position is then compared to nominal and a compensation table is generated. Based on that compensation table, positional refinements occur and move the robot into the correct location. As a result, after a successful setup and mapping process, accurate hole locations and trim profiles can now be achieved before the first part is ever cut.

Currently, the Tracker is used several times a week to inspect aircraft sub-assemblies and hard tooling. The large working volume, superior accuracy, and versatility make the Laser Tracker the only practical tool for many of the large parts Cirrus fabricates.

The FARO Laser Tracker allowed Cirrus to take measurements in real time while manipulating the robot, instead of cutting a part or drilling a hole before measuring it and making adjustments based on the data. The Tracker also allowed Cirrus to keep its traditional CMMs focused on their existing production parts.

Results

Cirrus was able to use the FARO Laser Tracker to realize a 60% reduction in tooling costs by minimizing the quantity and complexity of trim and drill fixtures. This, paired with the agility of the robotic system to rapidly accommodate design changes, will lead to an overall reduction of time and cost for the entire SF50 Vision program as it nears FAA certification. The FARO Laser Tracker Vantage proved to be the comprehensive solution that Cirrus was seeking, as the ideal tool for robot calibration, tool design, fabrication, validation, and adjustment.



"Though the robot calibration is a unique application, Cirrus has also utilized the Tracker with other large scale needs such as assembly and bond fixture setup, component inspections, and even entire aircraft inspections," said Metrology Engineer Tom Collard. "The FARO Laser Tracker has and will continue to be a valuable tool in Cirrus Aircraft's arsenal of success, both now and into the future."