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The eighth axis of the FARO 8-Axis Design ScanArm is the rotary stage in the center. (Image courtesy of FARO.)

The FARO 8-Axis FaroArm® and ScanArm Offer a Rotary Stage for Faster and Easier Scanning

Until now, 3D scanning has been limited to seven degrees of freedom. This describes the freedom of motion of an articulating measurement arm, like the one shown above, that attaches to the scanner or probe. With FARO's latest product, the 8-Axis Design ScanArm, 3D scanning now has eight degrees of freedom. However, the company hasn't changed the standard arm design by adding an eighth axis to the setup. Rather, the eighth axis is a rotary stage that's physically separate from the eight axes of the articulating arm, but integrated into the system via cable.

Users place the object they wish to scan on the stage, and then rotate it to capture the full range of their object.

Despite its physical separation from the arm, the rotary stage is as integrated with the system as any other part of the system. It uses the same mechanical encoders and cartridges as the joints in the arm, and is connected to the base of the arm by a cable.

"There's no accuracy loss with the 8th axis ... [it] has very similar or the same performance as the rest of the arm. You essentially have a remote point of articulation that you can sit next to the arm. You can place your part on top of it, rotate it around, and position it however you need to capture it."

Orlando Perez,
Chief Platform Owner, FARO Technologies

As the Stage Turns

One of the most apparent advantages of the eighth axis rotary stage is the freedom it offers to 3D scanners. Going from seven to eight axes may not seem like a huge leap, but users of the system will appreciate how it simplifies the process of scanning.

“The eighth axis is a rotary encoder stage. It’s synced up to the arm at the back of the base. And when I rotate this encoder, it will essentially note where it’s being locked down. So, instead of having to reach around the part or walk around the table, I just have to move the encoder and everything will sync up.”

Chad Crisostomo,

Platform Owner, FARO Technologies

With the option to rotate the target object, users of the FARO 8-Axis arm don’t need to awkwardly reposition themselves to scan all sides of an object. Not only does this offer greater convenience to the user, it also means greater flexibility in where the system can be set up, since less space is required to properly scan the object.

Before it can be used, the rotary stage requires a quick calibration. This entails tracing the rim of the stage twice with the probe on the end of the FaroArm. Doing this allows the system to ascertain the central axis of the platform. Afterward, the rotary stage’s encoder does the rest.

“There’s actually an encoder on the bottom,” Crisostomo explained. “That’s the same encoder that we manufacture here at FARO, and that’s what syncs up the table. After I find the center location of the axis, it already knows based off the movements of the encoder how it’s going to interact with the arm.”

Calibration complete, the scan can begin. Users start by grasping the laser line probe on the end of the arm. FARO recently introduced the FARO PRIZM™ Laser Line Probe, which is the company’s first high resolution color scanner. With the PRIZM, users can capture both the geometric and color details of their object, offering several additional advantages which we discuss in another article.

With the laser line probe in hand, users scan an object in the traditional way by “painting” it thoroughly with the laser. The difference is that

the object rests on the 8-axis rotary plate. With one hand on the laser line probe and the other on the rotational stage, users can spin the object 360 degrees to paint it entirely without ever moving their feet. Users can watch their progress in Geomagic Design X, scanning software from 3D Systems that is available bundled with the 8-Axis arm (or any other compatible point cloud software). Whenever users rotate the stage, their point cloud rotates likewise in Design X.

“We tout speed, accuracy and ease-of-use,” Crisostomo said of the process.

The 8-Axis System

The 8-Axis system is available for both the FaroArm, FARO’s original coordinate measuring machine (CMM), as well as the ScanArm, a FaroArm equipped with a laser line probe for noncontact measurements. The laser line probe returns 2,000 points per line at a refresh rate of 300 lines per second, resulting in an impressive 600,000 points per second (240,000 if color is turned on). All processing occurs onboard, meaning users aren’t held back by limited computing resources.

“The points and the color information is all [done via] onboard processing. So, unlike other devices out there that are very dependent on the computer hardware, ours is not.”

Ken Steffey,

Director of Product Management,
FARO Technologies

Regardless of which system you’re using, the eighth axis blows open the accessibility of 3D scanning. Large, bulky or heavy objects can be placed on the rotary stage and rotated as needed. Users can not only access all sides of an object more easily, but they can also access the underside of objects that extend off the stage. Such a process obviates the need for multiple scans and constant repositioning of an object.

How the Tables Have Turned: FARO® Adds an 8th Axis to 3D Scanning



A large model train sits atop the rotary stage to make scanning the complete object much easier for the user. (Image courtesy of FARO.)

This is a huge boon for industries like automotive aftermarket, in which users often scan bulky objects like car doors and engine blocks.

“Object handling is actually the most critical part of the digitization process. If you mishandle an object, like Neil Armstrong’s glove, it’s one of a kind. If something were to happen to the object, that would be a tragedy. So, any scanning solution that minimizes object handling is beneficial.”

Vincent Rossi,
Senior 3D Program Officer, FARO Technologies

Besides providing quicker and more hassle-free scans, minimizing the amount of times you have to reposition a scanned object is crucial for some applications. The Digitization Program Office at the Smithsonian Institute, for instance, scans many old and historical objects for posterity. In this line of work, conscientious object handling is the number one priority.

Finally, the 8-Axis system offers an advantage that can be appreciated across all industries: it’s space saving. With the ability to scan objects entirely from one side, users are less constrained by where they can place their FaroArm or ScanArm. Combined with its quicker and easier scanning capabilities, the FARO 8-Axis system ultimately offers users a new axis of convenience.

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