



TOUCH OF CLASS: This robot end effector is automatically touch calibrating, by sensing motor torque levels, on the vacuum chuck of a semiconductor wafer pre-aligner.

SEMICONDUCTOR MANUFACTURING

See Me, Feel Me

Laser mapping, touch sensitivity drive automated robot calibration

RICHMOND, CA—It may be hard to think of a connection between offshore welding of oil pipelines and integrated circuit wafer handling. Thanks to Berkeley Process Control (www.berkeleyprocess.com) looking to leverage its technology skills, there fortunately is.

Teaming with J. Ray McDermott, an energy services company, the company developed an automated welding system for joining sections of pipe being laid underwater from barges. The objective was improved process control and productivity. The system's machine control and calibration technology uses lasers to detect the geometry of junctions between the beveled ends of 20- to 30-inch diameter pipe sections. Touch sensitivity, by detecting torque levels in robot positioning systems, allows precise location of six welding

torches at each of five stations. Networked Berkeley motion-and-machine controllers provide real-time management of 14 servo axes on each station, the automatic weld-seam tracking system, and the automated welding process.

Berkeley Director of Engineering, David Taylor, notes the laser mapping and touch calibration for the weld system led directly to its Autocalibration® technology that is seeing use in wafer handling. Application to wafer handling came about, says Taylor, from Berkeley looking for other uses where its technology could be used "to remove operator dependencies and subjectivity from machine set up." And in semiconductor manufacturing, this could involve several hours of teaching a handling machine positioning routines, and is only as accurate as the person teaching the robot. Because of the laser-mapping location and touch sensitivity, this time is now reduced to minutes, he adds.

Previously, teaching a handling robot involved manually jogging the robot along the proper path to the "teach points." This process is highly "eyeball" dependent and can involve having the programmer in awkward stances to observe the robot's end effector. With Autocalibration, a pre-programmed calibration routine is executed to find physical reference features via various sensing methods (laser mapping, touch, etc.) to learn all of the wafer handoff positions.

When asked why it couldn't be done previously, Taylor says that the company's BX series motion-and-machine controller "tightly couples motion and I/O in monitoring motor torque," which is vital for the automated system to determine precise touch points by a robot.

Such efficacy of the Autocalibration technology is born out by Heinrich Walk, a director with ASYS GmbH (Schorndorf, Germany), a maker of vacuum chamber wafer handling system robots. "We had to integrate the whole control system into our equipment without using external racks and other control devices. The high level of integration of the BX controller caught our attention. The 64-bit RISC-based, multitasking, shared state information technology gave us confidence that important features like Autocalibration, robot self-diagnostics, and the adaptive control algorithm would work well," he states.

Taylor cautions, not all stations in a handling system can use just lasers and touch calibration to determine effector position, and these must be accounted for. Calibration can also be reflective or through-beam optical sensors when contact is not desired to prevent damage.

Taylor adds that the system is a user configurable software application rather than needing custom solutions for particular customers—allowing users to set up without writing software.

Himanshu Shah, senior analyst with ARC Advisory Group (Sewickley, PA), notes, "Autocalibration can also eliminate manual setups in other industries due to inconsistencies in products, variability in machine parts, or lack of knowledge of exact work space dimensions. Autocalibration technology can be extended effectively across applications ranging from special machinery to packaging lines."

—Rick DeMeis