

slipped into a slot. The results of analytical measurements could help the robot adjust its sample preparation procedure, as well. For the most part, these senses register only success or failure, with no intermediate degrees of "not quite right." The coupling of some artificial intelligence—a rational decision-making faculty assisted by sophisticated visual or tactile sensors—is a holy grail much farther down the road.

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A NOTE ON THE LEADER

The laboratory robot had its beginnings as a simple material-handling device in 1982, when Zymark introduced its first machine as a device for moving samples into the analytical instrument. The Zymate's designers selected a cylindrical design well suited to machine-feeding motions, with a twist of the wrist for pouring.

Today, a robot like the Zymate II can rotate through more than 360° on its base (making a quarter revolution in about 1.3 seconds). It can lift its 3-oz payload about 22 inches from the bench surface (at up to 4.3 in./s) and has a boarding-house reach of about 26 in. Its wrist will roll through a full 360°. And the robot can position itself to within 0.1 in. of its programmed destination (that's its accuracy), and will come to rest within about 0.05 in. of the same position every time (its repeatability).

Programming a robot is getting easier, too. No longer must one be a roboticist to get the results one needs. Under the name of "Py-Technology," Zymark is promoting highly modular robotic systems, using common devices fixed on mating pie-shaped platforms, combined with standard pre-programmed operating routines. Right now, hardware-and-software modules are available for a general-purpose hand, a vibrating hand (for pouring powders), tube and plate racks, solvent delivery systems, pipetting (1 and 5 ml), weighing, dilution and dissolution, vial crimp-capping, screw-capping, liquid-solid extraction, liquid-liquid extraction, linear shaking, centrifugation, evaporation, membrane filtration, LC and GC injection, spectrophotometry, Karl Fischer titration, and data management. ■



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