SENSOR FEEDBACK AND THE RISE OF COLLABORATIVE ROBOTS

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One of the most interesting developments in robotics is the emergence and growing popularity of so-called collaborative robots, or cobots. Cobots, in contrast to traditional industrial robots, are designed to work side-by-side with human workers in a shared workspace. They are typically smaller and less powerful that traditional robots and are equipped with a variety of proximity sensors, load sensors, and other features designed to reduce the risk of dangerous interactions with the people working around them. This focus on safety means that cobots are easier to deploy in a normal factory setting, since they don't require special fenced off operating areas. Cobots are also designed to be easy to program, so that setup is simplified and a cobot can be easily and quickly reconfigured for new tasks. Cobots have been used to perform repetitive tasks in light assembly, packaging, materials handling, and medical laboratories. Remote and minimally invasive surgeries are another area of application. Cobots are also used in environments where direct human interaction could be dangerous, including high temperatures, chemically aggressive reagents and toxic pathogens, to name a few. (In particularly harsh environments, cobots designed for normal factory operations may require special measures such as protective wrapping or extended end-effectors to ensure reliable long-term performance.)


Collaborative robot in the workplace (Photo courtesy of Universal Robots A/S)

One of the most popular cobot configurations mimic a human arm, with flexible "shoulder", "elbow" and "wrist" joints (See Figure 1). Another common design is autonomous transport vehicles that can move goods through crowded warehouse or factory space.

Enabling Technologies for the Cobot Revolution

An important factor in the increasing popularity of cobots is that they are typically significantly less expensive than their larger counterparts, with lower power requirements. This reduction in cost has come about through the availability of innovative supporting technologies that enable high-performance, miniaturized components and control systems. This includes powerful microcontrollers (the 'brains' of the devices), compact, precise servomotors and actuators (the 'muscles'), and sensors that provide the control system with a sense of touch, along with information about the position of objects—including the robots themselves—in the workspace. Communications technologies such as industrial Ethernet have also contributed by making it easier to integrate cobots into larger production systems.

Cobots, like more traditional robots, rely on position sensors to provide reliable feedback about their spatial orientation in a complex, dynamic workspace. For arm-mimicking cobots, information about the location of their mechanical components in space is typically provided by sensors called "rotary encoders" mounted at each of the device's joints. These sensors monitor rotations at the joints and


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return digital signals that report angular displacement (absolute encoders) or rate of motion (incremental encoders). The 'right' encoders for cobots need to be accurate, reliable, and have excellent dynamic response. They also need to be compact enough to fit into complex joint assemblies. Sensor manufacturers, such as POSITAL-FRABA, have responded to this challenge by developing new sensing technologies, such as magnetic and capacitive rotary encoders that can deliver high levels of performance, along with a wide range of mechanical configurations and communications interfaces, all at affordable prices. Since these encoders feature built-in microcontrollers, their measurement characteristics can be modified in-situ through software updates, without requiring any changes to the mechanical components.

Encoder components must be available in a variety of shapes and configurations to give cobot designers the flexibility they need to build compact, high-performance devices. CA