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Works Well with Others: Collaborative Robots Interacting on the Assembly Line

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By combining human coordination and reaction speed with robotic precision, cobots are carving their own niche in the automotive industry and will soon be adopted by other industries.

A common vision of the assembly line of the future is of a mechanical environment dominated by robots, with little or no room left to spare for the traditional line worker. Indeed, many companies today utilize fully automated assembly lines. The automotive industry only employs human assembly in the final third of its car-making process. The traditional places for human line workers have been those tasks that require tactile coordination and quick judgment. However, a new type of robot is being introduced into these areas of human expertise as well. But line workers need not worry about their job security just yet. This innovative robot, known as the "collaborative robot", or "cobot", is an intelligent assembly device that works in conjunction with assembly line workers, rather than in place of them, with the goal of actually making their jobs easier. Differentiating these machines from conventional robots is the fact that cobots rely entirely on their human operators for both movement and control.

Developed by Ed Colgate, associate professor at Northwestern University and president of CoMoCo, Inc. (Collaborative Motion Control, Inc., Evanston, IL), along with colleagues Michael Peshkin and Witaya Wannasuphoprasit, the cobot is intended to augment the assembly process in situations that require the lifting and placement of bulky materials into compartments, i.e. in the general assembly stage of trucks. At a particular point in the truck manufacturing process, human workers need to install instrument panels into the cabs of the trucks as they move along the assembly line. Without guidance, this type of movement can be very difficult, and even dangerous. The worker is required to lift the heavy panel, oftentimes twisting his or her back while doing so, and fit the panel through the opening of the truck door. The use of a cobot would not only hold the panel for the worker but also provide a smooth virtual surface for it to move along. The worker would then be able to slide the instrument panel into the truck without banging it against the side of the door.

The cobot accomplishes this feat by confining the trajectory of the object along computer-defined pathways. The cobot itself moves on free-rolling wheels, the speed and direction of which are monitored by an encoder. It is important to note that unlike conventional robots, cobots are not motor-driven. The only motor that they require is a tiny servo-motor to steer, but not to power, its wheels. The robot moves only when the operator applies force to a handle.

The cobot rolls in its guided direction until it reaches its programmed boundary; in this example, the confines of the truck cab. When it reaches this boundary the computer takes over, turning the wheels parallel to the boundary and allowing the held object to move only along the periphery. The virtual surfaces it creates to move along are invisible, of course, but the worker cannot help but feel their presence. These "felt" surfaces extend out of the cab like an imaginary funnel. Because of this, the held unit slides directly into place no matter how awkwardly the worker pushes it. The computer-defined "funnel" saves the line workers from having to worry about hurting themselves or damaging the truck's frame.

With these benefits in mind, it should come as little surprise that cobots are being developed under a grant from the General Motors Foundation. In fact, they are already being used at both GM and Ford on an experimental basis with positive reviews. According to Prasad Akella, a senior project engineer at the Robotics Engineering Department in the North American Operations Manufacturing Center of GM Corp., "Cobots are useful for many of the tasks that fall somewhere in between – tasks in which a worker's abilities to see, feel and react are

needed, but [where] it is also desirable to spare the operator from having to perform certain physically taxing motions."

With a "thumbs-up" from the automakers, other industries are almost sure to follow their lead. Cobots are ideal for doing tasks that fall between manual and automated. They preserve a worker's ability to use his or her judgment as needed and, at the same time, eliminate the strain of performing potentially dangerous work. The possible market for cobots has yet to be fully explored but one might venture that their relevance to all facets of industry is near limitless. Within the space of a few years, cobots might revolutionize the manufacturing process as we know it.

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