Putting Collaborative Robots to Work

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Collaborative Robotics

Until recently, industrial robots were considered dangerous machines. To effectively use them and keep people at a safe distance, they had to be enclosed in a cage or guarded with safety equipment (Figure 1). If interaction with the robot was required, the robot had to be restricted from entering the same working area as the operator, or it needed to stop until the operator was beyond its reach.

Figure 1: A robotic material-handling system guarded by fencing

In the last few years, the concept of robot safety and guarding has changed with the rapidly growing popularity of collaborative robots, also known as "cobots." In 2014, cobots represented just 5% of the industrial robots in use. According to a report from the market research firm Markets and Markets, the global cobot market is expected grow from $110 million USD in 2015 to $3.3 billion USD by 2022.[1] In 2012, there were only two notable cobot manufacturers, and neither was a major robot supplier. Today the majority of industrial robot suppliers have created products for the cobot market space. There are now many different shapes, sizes, and capacities of cobots to choose from depending on the application.

Why Cobots?

Cobots include mechanical compliance or force-feedback detection to stop the motion of the robot when contact is made with a person or object. This allows cobots to safely operate in the same workspace as humans. In addition, since people working near a cobot cannot be hurt by it, extensive safe-guarding and safety control interlocks may no longer be required, resulting in a number of significant advantages:

- Operators and cobots can work side-by-side, reducing floor-space requirements (Figure 2).
- Efficiency increases since the cobot does not need to be moved out of the way or shut down when operator interaction is required.
- Since no safety zone is required, existing factory layouts can be used.
- Cobots can be moved between stations and applications with minimal effort and without removing and reinstalling barriers.
- The capital cost of a cobot work cell is reduced compared to traditional industrial robots, as is installation time and cost.
- Software controls required for the coordination and operation of the cell environment are reduced.

Figure 2: Kawasaki Robotics duAro cobot working on an electronics assembly line (courtesy of Kawasaki Robotics)

With the reduced cost of implementation and, in many cases, the reduced cost of the cobots themselves, this technology is attractive to small-to-medium enterprises that are looking to automate their manufacturing processes.

Cobot Limitations

Although cobots have come a long way, there are still a number of limitations keeping them from replacing traditional industrial robots. The total capacity of the largest cobot is 35 kg, with the majority having capacities of 10 kg or less. In comparison, the standard industrial robots made popular by the US automotive industry have maximum capacities between 120 kg and 200 kg. Today's largest industrial robots have maximum moving capacities ranging from 1500 kg to 2000 kg, depending on the manufacturer. As such, cobots are currently only suited for lighter material-handling and continuous-path operations.

In practice, cobots are generally slower than their traditional industrial counterparts. While some cobots are able to reach operating speeds of 1.5 m/s, this is commonly reduced to a safe level to minimize the impact forces that a human operator would experience in the case of a collision. Operating speeds can be increased by using additional padding on the cobot itself and through the use of safety scanners. The latter can be set to detect an operator's entry into a cobot's working area and trigger a reduction in speed to a safe level. In comparison, typical industrial robots operate at linear travel speeds ranging from 1 m/s to 3 m/s, with some delta-style robots reaching speeds of 10 m/s.

Cobots cannot guarantee safe operations for every application. In the case of a dangerous end effector such as a knife or welding torch, safe guarding is still required. In these cases, while the cobot itself is safe, the end-of-arm tooling can still cause injury. In addition, the cobot must be configured to ensure that all potential impacts are deemed acceptable per the applicable safety standard. To accomplish this, all possible impact scenarios must be pre-determined, along with the amount of force that will transferred. The cobot's settings must then be adjusted to bring the impact forces within acceptable limits, and these forces must be verified before the cobot is considered safe. An overview of cobot safety will be discussed in a later paper.

To date, repeatability is an area where cobots have underperformed slightly compared to their industrial counterparts; however, this is quickly changing as major robot manufacturers zero-in on the market.

Applications

Successful implementation of cobots requires a clear understanding of their benefits as well as their limitations. Currently, applications with slower cycle-time requirements that can tolerate lower processing speeds and lower repeatability are good choices, as are applications where the end-of-arm tooling is safe or can be made safe with some modification. Cobots are also well-suited for placement in manual manufacturing processes where space is limited. Promising applications include machine tending, sealing, inspection, sorting, packaging, assembly, dispensing, sanding, polishing, and inserting of screws. Example applications are provided in Figure 3 and Figure 4.

Figure 3: Robotic arm performing a packing operation

Figure 4: Robotic arm applying sealant to automotive glass

How EWI Can Help

EWI has significant expertise in the effective utilization of cobots. We use this expertise to empower our customers by (1) assessing manual operations and determining equipment needs for a "cobot" conversion, (2) determining applications where changing from standard industrial automation to collaborative automation can yield the greatest benefits, and (3) proving out new automation processes on our Feasibility Factory Floor using the latest cobot technology (Figure 5).

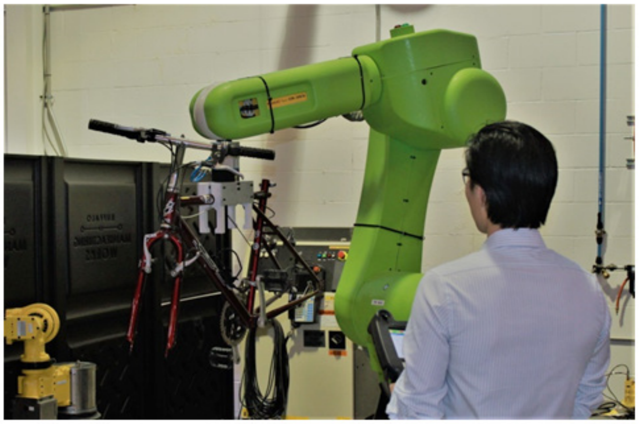

Figure 5: EWI engineer working on a cobot application

For example, EWI's automation experts are currently developing a cobot application to insert screws into electronics assemblies, allowing the operator to build the product in parallel. EWI is also developing an application where a two-armed cobot is used to inject potting material for the encapsulation of electronic coils. In addition to improving quality and increasing output, this allows the operator to conduct parallel tasks.

References

1. "Collaborative Robots Market by Payload (Up to 5 Kg, Up to 10 Kg, & Above 10 Kg), Application, Industry and Geography - Global Forecast to 2022", *MarketsandMarkets*, 2016.

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