THE RELEVANCE AND IMPORTANCE OF ARTICULATED ROBOTS IN GLOBAL AUTOMOBILE MANUFACTURING INDUSTRY

Blake Kadar & Ian Parker

ABSTRACT

In automobile production, robots are integrated into the production line to perform tasks such as painting, welding, and assembling car parts. Ultimately, robots contribute to the finished product. Robotics have become more prevalent in the factory process. The industrial robot is a revolutionary product in large-scale manufacturing. With the articulated robot, the possibilities of creating highly technical products more efficiently and effectively are boundless. The use of articulated robots makes the production of new, innovative technology possible. In an industry where precise measurements are crucial to the production and safety of products, these robots provide a more effective alternative to human laborers in certain tasks. Articulated robots allow for increased safety and efficiency by removing human error in the manufacturing process. The applications and mechanics of the articulated robot increase the efficiency of mass-production and provide revolutionary benefits to industrial manufacturing.

HISTORY OF INDUSTRIAL ROBOTS

• The Industrial Revolution created a need for mass production.
• Early industrial machines were mechanically powered.
• The first industrial robot (Unimate) was created by George Devol and Joseph Engelberger in 1956.
• Henry Ford became aware of the opportunity associated with these new robots and had Unimate robots installed in his factories.
• Cincinnati Milacron unveiled the first microcomputer-controlled robot in 1974. This robot, called the T3, was installed into many Volvo plants to accompany the existing Unimation robots.
• Since then, development of industrial robots has focused mainly on sensors and programming.

HUMANS AND ROBOTS: SAFETY

• Safety-oriented programming is necessary so that workers don’t get hurt when interacting with robots.
• A study analyzed multiple path-planning algorithms for efficiency and safety based on a factor called “danger field.” Danger field is measured based on the level of danger to the surroundings of a robot due to the current position and velocity of that robot at any given time.
• Two versions of the algorithms (one programmed with safety in mind, the other not) were put through a simulation that required a simulated articulated robot to achieve a configuration in the safest manner possible.
• The results concluded that the safety-oriented algorithms produced much safer movements (more DF computations) from the robot, with a slight decrease in time in some cases (Table 1).

Algorithm | Avg. time (s) | DF (danger field) computations
--- | --- | ---
BUBBLES (safety OFF) | 1.6440 | -
BUBBLES (safety ON) | 1.4040 | 454
PRM | 2.9351 | -
SAFE_PRM | 1.8768 | 265
RRT-Connect | 0.7296 | -
SAFE_RRT-Connect | 0.6280 | 84
JT-RRT | 0.7221 | -
SAFE_JT-RRT | 0.4267 | 47

Table 1. Numerical results of the algorithm testing

USAGE

• Articulated robots are machines with joints that allow for increased mobility.
• The six-axis robot is a specific type of articulated robot that uses its multiple joints to move in all directions with precision to perform complex tasks (Figure 1).
• The robot is often used in many cutting processes as the guidance system for lasers used in three-dimensional plastics milling and car assembly.
• Robots are controlled by computers that give detail cutting paths based off of Computer Aided Drafting designs.
• Six-axis articulated robots are used to create many plastic interior automobile parts such as the plastic pillars that join the roof to the car body.
• The robots are also used in other processes such as material movement.

EFFICIENCY

• The six-axis robot offers a more energy-efficient alternative to perform multiple manufacturing jobs as opposed to other robots and, in some cases, humans.
• The multiple axes and ability to work in a three-dimensional plane make the six-axis robot more widely used than many other industrial robots.
• A computer system is connected to the six-axis robot to evaluate the robot’s production using a complex algorithm to calculate the energy expended by each movement.
• The computer can change the robot’s movement path based on information from previous work to create a loop in which the actions of the robot are constantly evaluated and changes are made to continuously increase the efficiency (Figure 2).

THE FUTURE

• For complex tasks in final assembly for automotive plants, an increase in production of smaller and more exact articulated robots might be needed.
• Cheaper force/torque sensors for 6-axis robots might be needed to allow safer and more precise movements from robots in large-scale manufacturing.
• Classic articulated robots programmed to perform one job might be replaced with more task-flexible robots. Advances in computer programming might allow one robot to carry out multiple jobs that previously might’ve needed 3 or 4 robots.
• Safety-oriented path planning might ensure safer and more efficient articulated robots in the workplace, protecting the workers from injury who interact with them.