



CONCEPT Control loops enable robots to continuously monitor and adjust their movements in real-time, ensuring that they reach their intended target with the required speed, position, and orientation. By using sensors to detect the robot's current state, such as its position, velocity, and acceleration, control loops can make accurate predictions about the robot's future state and adjust its movements accordingly. This feedback loop allows robots to adapt to changing conditions and disturbances, such as uneven terrain, unexpected obstacles, or changes in payload, ensuring that they can perform tasks safely and efficiently.

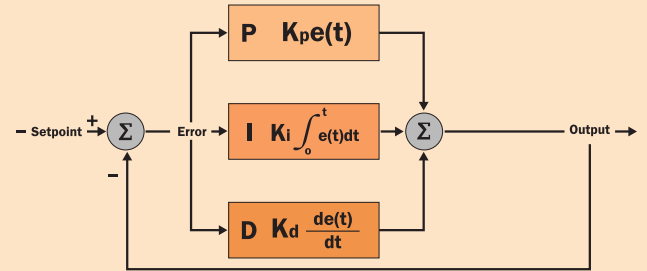
BACKGROUND

The first industrial robots were programmed to follow a pre-defined path using open-loop control, which did not account for any external disturbances or changes in the environment. However, as robots became more complex and versatile, it became clear that closed-loop control systems were necessary to achieve accurate and precise motion control. The development of sensors and microprocessors in the 1970s and 1980s allowed for the implementation of feedback control systems in robotics, enabling robots to adapt to changing conditions and disturbances in real-time. Today, advances in artificial intelligence and machine learning are further expanding the capabilities of control loops.

REAL WORLD CONNECTIONS

Many companies rely on warehouses and logistics centers to store and distribute their products, and the use of robotics is becoming increasingly common in these facilities to reduce costs. Control loops control the motion of robots, such as automated guided vehicles (AGVs), that move products around the warehouse or a logistics center. These robots are equipped with sensors that detect their position and the position of the products, and the control loops use this feedback to adjust the robot's movements to ensure that it moves with the required speed, position, and orientation. This enables the robots to transport products efficiently and accurately, reducing the need for human labor and improving the overall productivity of the warehouse or the logistics center.

Make sure it measures up



EXAMPLES

SENSOR: Detect the robot's current state, such as its position, velocity, and acceleration. These sensors provide feedback to the control system.

CONTROLLER: Receives input from the sensors and calculates the appropriate control actions to achieve the desired output. It sends signals to the robot's actuators to adjust its movements.

ACTUATOR: Converts the control signals from the controller into physical movements. Common actuators used in robotics include electric motors, hydraulic or pneumatic cylinders, and linear actuators.

FEEDBACK LOOP: Allows the control system to continuously monitor the robot's movements and adjust its actions in response to any changes in the robot's environment or task requirements.

FORMULAS

PROPORTIONAL-INTEGRAL-DERIVATIVE (PID) CONTROL FORMULA: One of the most widely used control algorithms in robotics motion control. It consists of three terms - proportional, integral, and derivative - that are combined to create a control signal that is used to adjust the robot's motion.

TRANSFER FUNCTION: Mathematical representation of the relationship between the input and output of a control system. It is often used to analyze the stability and performance of control systems.

ROOT LOCUS: The root locus is a graphical representation of the poles and zeros of the transfer function in the complex plane. It is used to analyze the stability and performance of control systems and to design control systems that meet specific performance criteria.

