Commentary

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The Quality of Robust Control Strategies

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Description

Machines that can act in the same way that humans do are developed in robotics. In today's world, many robots are used in hazardous environments such as bomb detection and deactivation, inspection of radioactive materials, and clean-up and containment of hazardous materials and radiation) or in manufacturing processes where humans cannot survive. Robots can be used for a variety of other tasks as well. Robots can take any shape, but some are designed to look like humans. It is alleged that this will assist in the acceptance of robots in certain human-like replicative actions. These robots attempt to imitate human activities like walking, lifting, speaking, and thinking. The field of bio-inspired robotics is bolstered by the fact that many mode.

Kinematic Accuracy

Low exactness is as yet one of the significant snags to a more extensive usage of robots in industry and, particularly, an impressive obstruction to a greater utilization of cutting edge robot programming procedures which consolidate disconnected reproduction and computer aided design based frameworks. The ability of a robot to attain a required position in relation to a fixed absolute reference coordinate frame is typically used as the definition of robot accuracy. Because robot positioning is typically related to the definition of robot accuracy, Trajectory tracking can easily be included in this definition. The robot's ability to follow the prescribed trajectory within the absolute coordinate frame is the measure of accuracy. Repeatability, which is a measure of a robot's capacity to return to a position it has previously reached and memorized or its capacity to track the memorized trajectory repeatedly, is correlated with robot accuracy.

Even though they mean different things, robot repeatability and accuracy sometimes mix together: In performance data sheets, robot manufacturers frequently refer to repeatability as having the same value as accuracy. It goes without saying that high levels of repeatability and accuracy are desirable. However, because absolute positioning accuracy frequently exceeds repeatability by an order of magnitude, low accuracy of a robot is frequently regarded as a more serious issue because it effectively limits the robot to applications that can be satisfactorily programmed through "teaching by showing" methods.

A variety of factors affect the accuracy of robots. Kochekali and others divide them into six groups: parametric variation of kinematic parameters, influence of dynamic parameters, friction and other nonlinearities, including hysteresis and backlash, computational computer round-off and steady-state servo errors, application installation errors and workpiece position and geometry errors, and environmental changes in temperature, for instance. The elimination of their influence is the focus of extensive research aimed at increasing repeatability and accuracy. Position sensors are used by robots to determine their current position. There are either internal or external position sensors. The robot gripper's position and orientation in relation to an absolute coordinate frame can be directly obtained by the external sensors. However, due to their high cost and installation-related technical issues, such sensors are rarely used. On the other hand, the robot's internal coordinates, or joint displacements, are displayed by internal position sensors. Position and direction of the gripper are then determined deduced, utilizing the robot kinematic model. As a result, there is a difference between "internal" and "external" accuracy.

Internal accuracy is the precision with which an actuator reaches its predetermined position or follows its predetermined trajectory in joint coordinates. Steady-state servosystem errors, transmission nonlinearities from the actuator drive to the actuator output shaft, and poorly known gravitational moments loading the actuators all have a significant impact on the accuracy of the internal positioning. The steady-state error and load's impact can practically be eliminated with the right servo system selection. The transmission can be freed from the influence of deformation and backlashes by measuring the position on the output actuator shaft, but industrial robots rarely use this method due to their high cost. Modern robots for the most part display huge outside situating mistakes contrasted with the interior ones. offsets between zero-reference readings of position sensors and the actual zero positions of adjacent links, deviations of kinematic parameters from nominal values, and link deformations caused by static load are significant causes of the disparity between the internal and external accuracy The "kinematic accuracy" of the kinematic robot model is influenced by these factors, which also contribute to the inaccurate mapping of internal coordinates to external coordinates. New factors, primarily affecting the accuracy of internal trajectory tracking, emerge when considering the case of trajectory tracking. The imprecise understanding of the dynamic robot model is a significant contributor to the inaccuracy of the internal tracking: parameters of the actuator, inertia of the robot's links and the workpiece it is holding, and dynamic forces' deformation of the mechanism links.

Intelligent Control Systems

One can refer to the accuracy of the dynamic robot model as the "dynamic accuracy" by separating the dynamics of the mechanism and the actuator parameters that affect the accuracy of internal trajectory tracking. It has been emphasized that only when high-quality tracking of fast trajectories is required which is increasingly the case in robotic practice today does the need for precise knowledge of dynamic parameters arise. However, evaluating the quality of robust control strategies relies heavily on assessing the inaccuracy of dynamic parameters. Specifically, the structure of the mechanism and the control algorithm used determine how much the dynamic robot model's accuracy affects tracking accuracy.

There are a number of approaches, all of which use a variety of control laws to address the issue of manipulating robots accurately. In order to compensate for the effects of large irregularities during system operation, a variety of control systems are implemented, allowing for high-quality system operation in the face of significant system and working environment uncertainties. The objective of intelligent control system synthesis is comparable to that of conventional adaptive control algorithm synthesis. Intelligent control systems and adaptive control algorithms are similar in that the knowledge about the system is acquired directly during system operation through learning processes however intelligent control systems and adaptive control algorithms differ in that the uncertainty level of intelligent control systems can be somewhat higher than that of adaptive control algorithms. As a result of predetermined working requirements, the control system must perform additional functions such as associative reasoning in the face of uncertainty, learning, knowledge generalization and application of experience, multiple-level decision making, *etc*.