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OPTIMIZATION OF ROBOT MANIPULATOR MOTION ADAPTED FOR CONVEYOR PROCESSES

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Abstract
This article addresses the challenges and solutions for optimizing the motion of robotic manipulators used in industrial conveyor systems. Conveyor manufacturing processes require high precision and efficiency, which can be enhanced by optimizing the robot manipulators' movements. By refining the movement trajectories, planning sequences, and adjusting control algorithms, it is possible to improve operational efficiency, reduce time, and conserve energy. This study discusses methods of trajectory calculation, motion sequence planning, and speed-parameter adjustments for optimal robot control in conveyor settings. The article concludes with an analysis of the results achieved through optimization and the technologies applied.

Keywords: Robot manipulator, conveyor systems, motion optimization, industrial automation, motion trajectory, energy efficiency, control algorithms.

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Introduction

In recent years, there have been significant advancements in automating industrial production processes. Robotic manipulators are widely used in factories for conveyor processes, where they reduce human involvement and enhance operational speed and precision. However, without optimized movements, these systems may suffer from high energy consumption and reduced conveyor efficiency. Therefore, optimal planning and speed control of robotic movements play a crucial role in improving production efficiency.

1. Characteristics of conveyor processes and the role of robots: Conveyor systems typically operate continuously or discretely, with products transported on moving platforms. In these systems, robotic manipulators perform tasks such as sorting, arranging, and placing products. Robotic manipulators must accurately analyze the movement trajectory of items on the conveyor and select the correct path within a short time. Optimization challenges in this context are multifaceted, demanding precise and effective path-calculation algorithms.

2. Motion trajectory optimization methods: There are several approaches to optimizing the motion trajectories of robotic manipulators:

- **Mathematical modeling**: Calculating the robotic arm's trajectory through mathematical models and setting an optimal path based on model-driven control.

• **Genetic algorithms**: Using genetic algorithms to find suitable parameters for robotic movements and improve trajectories.

• **Data-driven control**: Leveraging real-time data and analytics-based control systems to optimize movement.

3. Adapting speed and parameters It is crucial for robotic manipulators to adapt to conveyor speeds. By optimizing movement speed, maximum productivity is achieved in production. Additionally, dynamic adjustment of parameters to suit various conditions can further reduce energy consumption and improve adaptability.

4. Energy efficiency and production optimization Optimization of movements can reduce energy consumption by robotic manipulators, increasing production efficiency and reducing operational costs. Furthermore, the efficient use of manipulator motions enhances their reliability over the long term.

Conclusion:

Adapting robotic manipulators to conveyor processes and optimizing their movements can bring substantial changes in production. This study highlights various optimization methods and approaches in this field and analyzes the technological solutions applied. Such optimizations increase production efficiency, improve technological and energy efficiency, and ultimately enhance industrial competitiveness.

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