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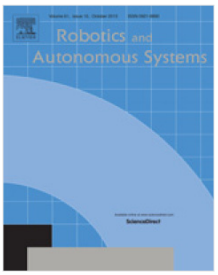

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Robotics and Autonomous Systems

Finger Design Automation for Industrial Robot Grippers: A Review

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ABSTRACT

Designing robust end-effector plays a crucial role in performance of a robot workcell. Design automation of industrial grippers' fingers/jaws is therefore of the highest interest in the robot industry. This paper systematically reviews the enormous studies performed in relevant research areas for finger design automation. Key processes for successfully achieving automatic finger design are identified and research contributions in each key process are critically reviewed. The proposed approaches in each key process are analyzed, verified and benchmarked. The most promising methods to accomplish finger design automation are highlighted and presented.

1. Introduction

This paper aims to review research contributions relevant for finger design automation. Designing functional fingers of robots is one of the most complex and sensitive criteria in robotics. The current iterative and time consuming procedure of designing fingers cannot fulfill the demands of agile manufacturing. Therefore, finger design automation plays a significant role in the competitiveness of the robotic automation in the agile market.
Designing gripper fingers properly can increase the workcell throughput, overcome robot inaccuracy and enhance overall system performance. Moreover, a poor finger design can damage the expensive robot hardware or the workpiece and consequently reduce the workcell throughput and reliability (Causey, 1999).

Industrial robots are designed in various sizes and payloads to fulfill a wide range of tasks. Some robots are dedicated to specific tasks, for instance welding, painting and cutting. These robots require special end-effectors called tools. Others are designed based on the task and operation environment to execute general operations, for instance *assembly* and *pick and place*. These end-effectors are the fundament of the review presented in this paper.

An end-effector is the only interface between the robot and the working environment. Therefore, the overall performance of a robot highly depends on its end-effector and research in this area is of high importance for the industry.

The present work addresses two major categories of robotic end-effectors; *hands* and *grippers*. Hands are multi-finger end-effectors with more than one degree of freedom (DOF) per finger (see Fig. 1 (a) and (b)) and grippers usually have 2 or 3 fingers with one DOF, as shown in Fig. 1 (c) and (d). Hands are designed for general purpose grasps while grippers are designed for more specific tasks.