Design and development of a linear jawed gripper for unstructured environments
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Abstract

Today’s manufacturers aim to reduce costs, increase agility, and automate processes - including high-mix, labour intensive ones. Grippers are used to automate most processes and are thus required to be precise, have fast cycle times, and have the capacity to lift heavy loads.

This paper discusses the ways to improve automated processes by implementing linear jawed grippers as a replacement for the current parallelogram grippers. Using various tools for CAD, analysis and simulation, an optimized linear jawed gripper has been designed. In order to provide precision and speed, an innovative feedback system has also been discussed using a combination of tactile sensors and current sense feedback techniques. The technical overview of the gripper is clubbed under three broad topics – Design and Analysis, Control and Electronic Design, Comparative Analysis.

Keywords: Current sense, industrial gripper, linear gripper, motor driver, tactile sensing, underactuation

I. Introduction

The end effector is a component providing the desired manipulation at the end of a robotic arm. It acts as the last link in any serial or parallel manipulator and is responsible for all operations the robot performs on a workpiece. The generic grippers are of three types – linear, level, and parallelogram (Figure 1).

The grippers designed for industries are required to manipulate heavy payloads in short and fast cycles. Such grippers use a variety of actuation methods – pneumatic actuators, worm and worm wheel, hydraulic actuators, etc.

The mechanically self-adaptive mechanism paves the way for the lightweight design of grippers which perform reliable gripping for a wide range of objects without the need for complex control [1]. In this paper, we propose a model linear gripper which employs a set of underactuated jaws as a replacement for the current grippers used in the industry.

Figure 1: Types of grippers

A. Linear gripper

The complexity of the grasping process is often underestimated since it looks very familiar for human beings [2]. The design of an industrial gripper must ensure proper handling of objects as well as offer maximum grip, precision, repeatability, etc. Further, the gripping action needs to be quick and the links should be able to apply a horizontal force equal to the weight of the workpiece times the frictional coefficient of the pad (µ). The workpieces vary in both size and weight, causing complexities in the gripper design due to less contact, inadequate work volumes and high reverse torques which inadvertently lead to gripper failure. Due to the excessive application of force, the workpiece can deform, wear, etc. thus, devaluing the product.