Fingertip Surface Optimisation for Robust Grasping on Contact Primitives

HKUST | Reference: TTC.PA.1111 | Nov. 2018

Background

Grasping is an essential ability for a robot, enabling it to physically interact with the world. Contact-based grasping, which explicitly considers the contacts made during a grasp, has been widely studied to address various aspects of grasping. Contact modeling is one of the basic building blocks of research on contact-based grasping. Depending on the friction at and softness of the contacts, form or force closure based grasp quality can be calculated in the grasp wrench space. However, analytic contact modelling is commonly acknowledged to have two major issues: 1) the point contact model does not precisely reflect the real physics; and 2) it is vulnerable to uncertainties in positioning, friction coefficient, visual perception, etc.

Technology Overview

In this work, we have addressed the problem of fingertip surface design by leveraging the observation that most grasp contacts on daily objects share just a few classes of local contact geometry. Accordingly, for fingertip optimisation, we first learn the most representative contact geometries from a set of grasps on sample objects, and then optimise the fingertip surfaces to maximally mimic the shapes of the learned contact geometries. Using the designed fingertips, we can find grasp contacts on an object surface that can maximally mimic the shapes of the fingertips, thereby improving grasp stability and robustness by maximizing grasp contact areas.

Market Analysis

The industrial robotics market was valued at USD18.05 billion in 2018, and its worth is expected to reach USD37.75 billion by 2024, at a compound annual growth rate of 12.15% over the forecast period (2019-2024). Industrial robots play a crucial role in manufacturing industrial automation, with many core operations managed by robots. With economic growth across regions, the e-commerce, electronics and automotive industries, among others, are on the rise.

- Industry 4.0, the newest industrial revolution, has fueled the development of new technologies, such as collaborative robots and AI-enabled robots, and allowed industries to use robots to streamline many processes, increase efficiency and eliminate errors. Increased workplace safety and improved production capabilities have further driven industries to invest in robotic systems.

- As industrial robots become smaller and cheaper without compromising on quality, the market is becoming increasingly attractive to key players in the end-user industry. However, larger investments may hinder the growth of the market. [1]

Benefits

- Improve stability of object grasping.
- Improve task efficiency by handling many objects through one set of fingertips.
- Extend the usability of robotic arms for complicated tasks.
- Agile deployment and cost saving through 3D printing.

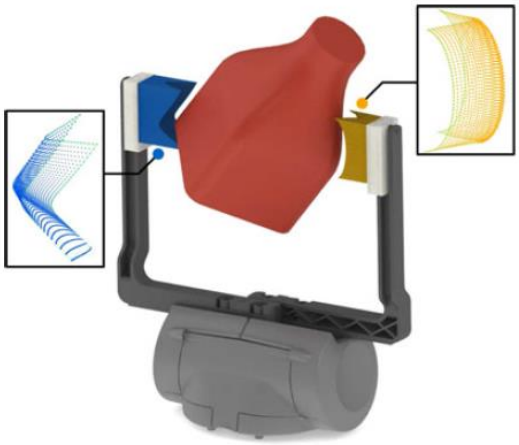
Applications

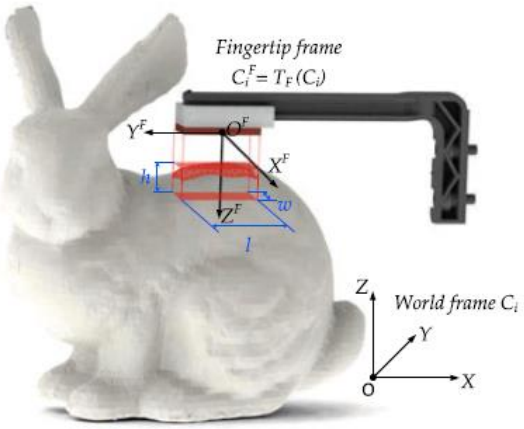
- Warehouse automation
- Large item manufacturing
- Robotics/original equipment manufacturing
- Cloud service for 3D printing shops

Patents

- US Patent no.: 16/192169
- China Patent no.: 201811368408.9

Figures





[1] 'Mordor Intelligence – https://www.mordorintelligence.com/industry-reports/industrial-robotics-market.