Journal of Applied Mechanical Engineering

Zhang, J Appl Mech Eng 2013, 2:4
DOI: 10.4172/2168-9873.1000e121

Editorial Open Access

Under-Actuated Robot Hand with Different Grasping Modes

Wenzeng Zhang*

Department of Mechanical Enggineering, Tsinghua Uni., Beijing 100084, China; Key Lab for Advanced Materials Processing Tech., MOE, China

Introduction

Kinds of robots have been widely used in the industrial processes. Service robots [1,2] are being developed for the handicapped and medical applications. To carry out a variety of service activities, a robot needs at least one hand which can grasp and manipulate various objects [3]. Humanoid robotic hands become focus of intelligent robot research for some characteristics of it, like many Degrees of Freedom (DOF), small volume, powerful output and complex control. For these and other reasons, the study of multi-fingered robot hands has greatly interested the research community since the early days of robotics.

Over the past three decades, research on dexterous hand has gained lots of achievements. Generally speaking, a dexterous hands has 3~5 robot fingers with 2~4 DOF each finger, whose joints are mostly driven by actuators actively. Dexterous hands have high flexibility to grasp objects while they highly depend on sensors, algorithms and control systems. Examples of dexterous hands include Stanford/JPL Hand, Utah/MIT Hand, DLR series hands, Robonaut Hand, Shadow series hands, UB hands, CyberHand, BH series hands by Beihang University and DLR/HIT series hands by Harbin Institute of Technology. The complexity of dexterous hands makes them high cost and low reliability.

Under-actuated robot hands can overcome some drawbacks of dexterous hands. In recent 10 years, they become more and more important in the field of robot hand research.

Different Under-actuated Robot Hands

According to grasp modes of available under-actuated hands, they could be classified into three kinds: coupled under-actuated hands, directly self-adaptive under-actuated hands and COSA hands (Coupled and Self-Adaptive Under-Actuated Hands). Fingers are the key components in a robot hand. Here one takes a 2-joint coupled finger as an example to explain different grasping modes.

2-joint finger with coupled grasping mode. If the first joint rotates, the second joint will rotate by an angle with a fixed proportion to the rotational angle of the first joint. The rotational proportion of the first joint and the second joint is determined by the coupled mechanisms. But if the lower phalange touches object before the upper phalange, the upper phalange cannot rotate any more. This means the finger cannot achieve complete 2-phalange grasping. Figure 1 shows the bending process of the 2-joint coupled finger. Typical coupled hands include Southampton Hand, MANUS-Hand, TBM Hand and SDM Hand.

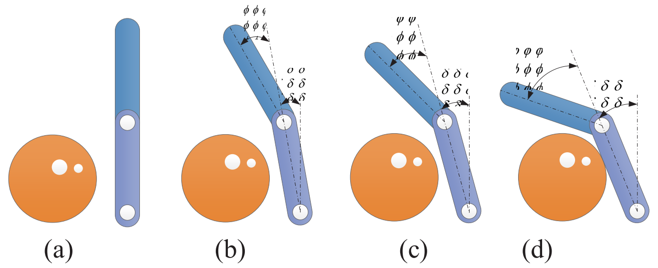

Figure 1: Grasp process of 2-joint coupled underactuated finger.

The adaptation is designed as a main function of directly self-adaptive under-actuated fingers. This kind of robot fingers can self-adapt to different sizes and shapes of objects. Directly self-adaptive under-actuated fingers cannot bend the middle joints before the first phalange contacts the grasped objects. This limits its appearance during grasping objects and ability to grasp small objects. Figure 2 shows the grasping process of a 2-joint directly self-adaptive finger. Typical self-adaptive under-actuated hands include SARAH Hand, under-actuated hands designed by HIT, LARM Hand, under-actuated hands designed by BH University, TH-3R Hand and GCUA Hand.

Briefly, the grasp ability of directly self-adaptive under-actuated hands is better than coupled under-actuated hands while grasp motion of coupled under-actuated hands is more similar to human hands than directly self-adaptive under-actuated hands.

The CDSA grasp mode includes 2 stages: coupled grasp and directly self-adaptive grasp. As shown in the Figure 3, the joints of CDSA robot finger rotate at the same time during the finger approaching objects gradually, which makes the motion of finger very human-like. After the robot finger touches objects, it can self-adapt to different objects, which

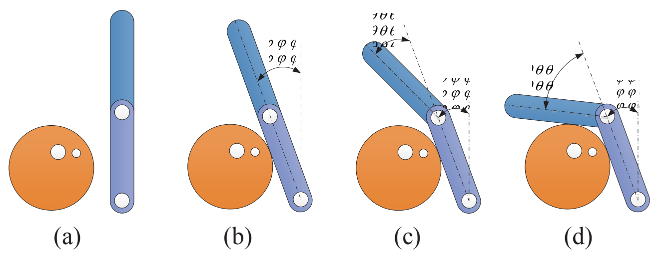

Figure 2: Grasp process of 2-joint directly self-adaptive under-actuated finger.

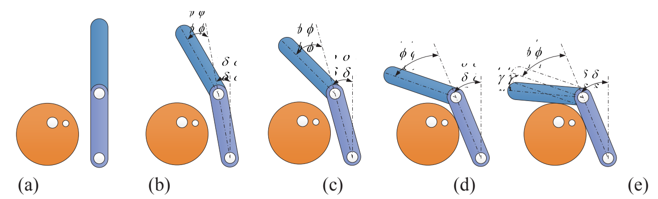

Figure 3: Grasp process of 2-joint COSA finger.

***Corresponding author:** Wenzeng Zhang, Department of Mechanical Enggineering, Tsinghua Uni., Beijing 100084, China, Tel: +86-10-62773860; Fax: +86-10-62773862; E-mail: wenzeng@mail.tsinghua.edu.cn

Received October 25 2013; **Accepted** October 25, 2013; **Published** October 26, 2013

Citation: Zhang W (2013) Under-Actuated Robot Hand with Different Grasping Modes. J Appl Mech Eng 2: e121. doi:10.4172/2168-9873.1000e121

improves the finger's grasp adaptability. Therefore the robot fingers with CDSA grasp mode have self-adaption and coupled function. CDSA robot fingers represent a new path for robotic finger design.

Future Work

In the literatures, a lot of researches about coupled under-actuated hands and directly self-adaptive under-actuated hands have been done. COSA mode has humanoid grasping appearance and can self-adaptive to various objects with different sizes and shapes. COSA hands have great potential to be good end-effectors for robots. In the future, researches focusing on COSA mode and COSA hand will be carried on.

References

1. Sakagami Y, Watanabe R, Aoyama C (2002) The Intelligent ASIMO: System Overview and Integration, in International Conference on Intelligent Robots and Systems 2478-2483.
2. Park IW, Kim JY, Lee JG (2007) Mechanical Design of the Humanoid Robot Platform: HUBO, Advanced Robotics 21: 1305-1322.
3. Kim EH, Lee SW, Lee YK (2011) A Dexterous Robot Hand with a Bio-mimetic Mechanism, International. Journal of Precision Engineering and Manufacturing 12: 227-235.