ABSTRACT

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Topic: SOME STUDIES IN MULTIFINGER ROBOTIC GRASPING

Keywords: Multifinger Hand, Grasp, Workspace, Mobility, Connectivity, Precision Grasp, Power Grasp, Tendon Friction, Contact Force, Grasp Capability, Finger Actuation.

The Human hand shows an extraordinary capability for manipulating and holding objects. The robotic research on grasping and manipulation till date has concluded the human hand as the most complex organ to imitate mechanically or to model perfectly. Robotic hands are being developed for many applications over last 2-3 decades, for dexterous manipulation, for work in human environments and with human interaction, and also as a tool of research to study human cognition. Even for robotic hands, the challenge of controlling a human-like hand, with its more than 20 degrees of freedom, leads many of the actual research towards a mechanical solution that, without compromising grasping and gripping abilities, could reduce the complexity in the control.

The traditional mechanical hands are simple two or three jaw grippers designed to perform specific task with specific tools. These simple grippers only enable the robot to hold parts securely but they fail to manipulate the grasped object. The inability of these simple grippers to adapt to a variety of grasps and the Lack of manipulation capability has demanded more robust and dexterous design. Multifingered hands with three or more fingers offer some

solutions to the problem of endowing a robot with dexterity and versatility. However, as the research progressed towards more dexterous hand with improved manipulability, the complexity of mechanisms involved increased to manifolds.

The objective of the present work is to develop and analyze a new multi-finger dexterous robotic hand that is capable of compliant handling of objects. The shape of the gripper is similar to human hand with a difference that it is developed with three fingers only and an opposing thumb. Each finger of the gripper is actuated by rope and pulley mechanism, hence the gripper can also be termed as tendon type gripper. The task is not predefined for this gripper, so, human hand and previous dexterous hands are taken as model during design. The CAD model for individual parts and assembly has been developed using Pro-E Wildfire 5.0 and simulation is done for grasping objects of different shapes. The position vectors for fingers and thumb are calculated using 3D surface plotter to conclude the workspace. The mobility analysis is done using the Modified Grubler's Equation for various grasped body shapes. The frictional behavior in tendon-pulley system of the robotic finger is discussed and its force output is analyzed. The contact force for grasp of the hand is evaluated both for precision and power grasp by considering the friction at the contact interface of object to be gripped and the gripper. The grasp capability of the hand is further investigated experimentally for various gripped objects to gain understanding for further modifications in the design.