NAZARBAYEV UNIVERSITY MULTIGRASP HAND AND ANTHROPOMORPHIC ROBOT ARM

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INTRODUCTION.

The robot arm uses a low-weight, low-inertia structure with variable stiffness shoulder joint for safe human and environment interaction. The potential applications of these robot arm and hand are in the fields of social and industrial robotics and prosthetics.

RESULTS AND DISCUSSION.

In this work, we are presenting our latest developments in the design and implementation of the Nazarbayev University Robot Arm Complex. Additionally, the 7-DOF robot arm is complemented with a multigrasp robot hand with an integrated RGB-Depth camera for intelligent object manipulation.

The hand consists of ten joints, which are actuated by four servo motors through five tendons. All Digits are capable of flexion and extension, whereas Digit I (thumb) can also perform adduction and abduction. Series elastic elements incorporated into the fingers allow differential coupling of Digits III-V, which makes conformal grasping possible. For acquiring data for intelligent object manipulation an RGB-Depth camera is integrated to the hand. In order to lower the cost and ease the assembly, the whole hand was printed using a 3-D printer. The total mass of the hand with all parts included is 550 g. The hand is capable of generating human scale finger forces.

Robot arm mimics the size and structure of a middle sized male human arm. Two DOF joints (at the shoulder and wrist) are tendon-actuated and one DOF joint is actuated by spur gears embedded inside the structure. Primary design specifications are low weight, low cost, human level joint ranges and torques, and safety during human interaction. The arm also leverages 3D printing extensively. The arm is capable of manipulating 1.5 kg objects within its workspace. Structure of human arm consists of antagonistic muscles, which allow concurrent position and stiffness control. When precise position control is required, stiffness is set to a high value. During the motion in unknown environments and in dangerous situations stiffness is set to a low value. Our arm has a spherical 2-DOF shoulder joint with variable stiffness, which is controlled by three MX-106 servo-motors connected in antagonistic manner using nonlinear series elastic elements. Future work includes integration of the robot arm with a humanoid robot torso for investigation of intelligent manipulation algorithms.

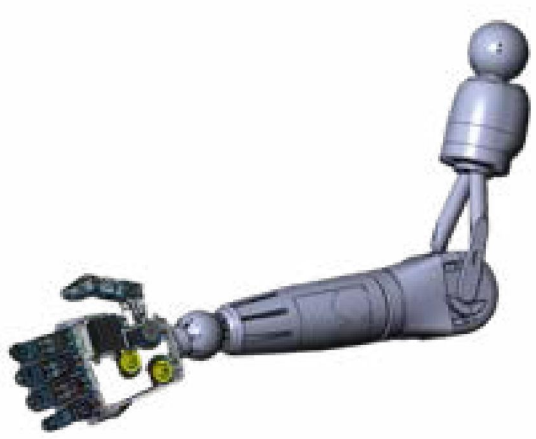

Fig. 1 – NU Robot Arm Solid Model.