DEVELOPMENT OF AN ANTHROPOMORPHIC TRANSHUMERAL PROSTHETIC ARM FOR UPPER-ARM AMPUTEES

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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DEDICATION

To the most courageous two persons who guided me to great achievements: my beloved father *Abeysingha Bandara* and mother *Kamani Mangalika*

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ABSTRACT

During the past few years there was a rapid development in robotic prosthetic limb technology to be used for the upper limb amputees. Anthropomorphic transhumeral arm prosthesis is proposed in this thesis to assist the activities of daily living of amputees. The prosthesis generates elbow flexion/extension, forearm supination/pronation, wrist ulna/radial deviation, wrist flexion/extension and another 11 DoF at the terminal device. In order to generate the wrist flexion/extension and ulna/radial deviation, a novel wrist mechanism is proposed based on the parallel prismatic manipulators. Two wrist motions occur in two different axes. The wrist design also follows the human anatomical structure. It is expected to realize high speed operation, higher positional accuracy and anthropomorphic features using the proposed mechanism. The arm prosthesis consists of an under-actuated hand as the terminal device with intrinsic actuation. A novel under-actuated mechanism is introduced as the finger designs, except for the thumb. The mechanism is capable of generating 3 DoF for the finger design. It further poses the capability of adjusting the finger joint angles passively, according to the geometry of the grasping object. With the intention of verifying the effectiveness of the mechanisms in motion generation, motion simulation and kinematic analysis are carried out. The results proved that the mechanisms are capable of generating the required DoFs to generate the lost motions of the human upper limb. Several experiments are carried out using the prototype of the arm prosthesis. Experimental results also proved the effectiveness of the proposed mechanisms for expected motion generation. Additionally a parameter to evaluate the finger designs of finger mechanisms is introduced and it measures the adoptability of the finger mechanism to grasp different geometries.

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