

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

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Thesis submitted in partial fulfillment of the requirements for the degree
Master of Philosophy

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Sri Lanka

December 2014

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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Prof. Kazuo Kiguchi

DEDICATION

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

ACKNOWLEDGMENT

First of all, I would like to thank my supervisor Dr. Ruwan Gopura for his excellent supervision, without whom I could not have completed my post graduate studies towards Master of Philosophy degree at Department of Mechanical Engineering, University of Moratuwa. It has been my fantastic experience to be working with him. On the one hand, he has given me maximum independence in pursuing my ideas and lots of encouragement. On the other hand he has provided thorough advice on research innovation and drafting papers as well.

Additionally I would like to extend my acknowledgement to the progress review panel members, Dr. Sanath Jayawardena (chairman) and Dr. Palitha Dassnayake (member) for their valuable suggestions and comments to improve the content of my thesis. Despite their busy schedules, I am appreciating their commitment given to conduct the timely progress reviews according to the schedule. Furthermore, I need to thank my co-supervisors Dr. K.T.M.U Hemapala and Prof. Kazuo Kiguchi, Prof. George Mann, Dr. Buddhika Jayasekara and Dr. Ranjith Amarasinghe for their valuable comments on my research and guiding me to the correct direction to be successful in achieving the final goal. A special appreciation is forwarded to my fellow colleagues; Mr. Malin, Mr. Thilina, Mr. P.D Welgama, Mr. Isuru and Mr. Kanishka for their support to make the final outcome of the research more important. I also thank the staff of the machine shops of Department of Mechanical Engineering. I especially thank Mr. Janath and Mr. Lasantha for their valuable support to fabricate the parts for the prototype of the robot.

Without the funding organization, the outcome of the research would not be a realistic. I thank National Research Council (Grant No. 11-067), Sri Lanka for their financial support given to succeed the research.

Last, but not least my warm thank goes to my family member. My father and mother motivated me to start my postgraduate studies and without that none of the research work would be a realistic. I also thank my brother and wife for their valuable sacrifices during the time of my research.

Sanjaya Bandara

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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