University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BSc (Harbin Institute of Technology, 2013)

"Mechanical Design and Simulation Studies of A Quadruped Robot Motion Control System"

Department of Mechanical Engineering

Thursday, March 8, 2018
9:30 A.M.
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Yang Shi, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Ben Nadler, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Hong-Chuan Yang, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Ryan Budney, Department of Mathematics and Statistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

This thesis focuses on mechanical design and motion control of a quadruped robot system, targeting at designing an autonomous legged robot.

The mechanical design of the quadruped robot is illustrated in Chapter 2, including the main body structure design, the leg structure design, the actuator selections, and the joints design. For all the designs, appropriate mechanical structures are utilized to minimize the energy consumption, which forms the main contribution of this thesis. Also, to swing the leg flexibly and to reduce the weight of the leg, the leg is designed by optimizing the mass distributions of the components in the leg mechanism. Finite element analysis (FEA) is applied to design the structural components and to verify the effectiveness of the mechanical structure design. The design process of the hip joint is demonstrated as an example in the last part of Chapter 2.

Based on the designed mechanical structure, the kinematic model and dynamic model of one compliant leg is derived in Chapter 3. Besides, the quadruped model is set up by using MATLAB/SimMechanics packages to emulate the dynamic locomotion. A Proportional-derivative (PD) controller is designed for the quadrupedal locomotion by executing motion planning and motion generation at each step. From the simulation results, it can be observed that the quadruped robot can execute a creeping gait with appropriate footholds.

Finally, conclusions of the thesis are summarized and future work is presented in Chapter 4.