University of Victoria | Graduate Studies

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

of

JOHN (JACK) KEEN

BEng (University of Victoria, 2003)

"Flight Telerobotic Servicer"

Department of Mechanical Engineering

Friday, August 21, 2015
11:00 A.M.
Engineering Office Wing
Room 502

Supervisory Committee:
Dr. Nikolai Dechev, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Andrew Rowe, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Poman So, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Christina Mynhardt, Department of Mathematics and Statistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

In 2010, a donation was given to the University of Victoria Robotics and Mechanisms lab by Roper Industries. It was a Flight Telerobotic Servicer (FTS) Right Finger training tool. This is an electro-hydraulic robotic arm, approximately eight feet long, weighing in excess of four hundred pounds. This arm was designed and built in the late nineteen eighties as part of a program in support of the Space Station Freedom project. The intention of the arm was to assist in the training of astronauts in the use of an end effector which would be mounted at the distal end of the Canadarm©. The end effector would have right and left fingers, as well as a thumb (used for stabilization, not grasping). Unfortunately, the robot did not come with any of the control hardware, software, manuals, or functional descriptions, and the original equipment manufacturers (OEMs) were not able to share any information regarding the nature of the controls. The focus of the present work is to re-animate this arm without additional feedback, operating the arm only by hand-eye control, using currently available electronics and hardware. Also, investigate the absolute position sensors. These are described as near-infinite resolution analog absolute position sensors. Investigation was also conducted on an alternate solution (Vernier Optical Encoder), which was finally were abandoned. Strain-gauge type torque feedback sensors were found to be functional, and can be used without further work on future experimentation. The outcome of the research and assembly is a fully functional electro-hydraulic robotic arm, which is digitally controlled using an XBOX© game controller, using only visual feedback for position. The position sensor work was not as fruitful, with no working position sensors available. The torque feedback sensors are functional, but not utilized in the final work.