**Title: Design, modeling, and control of a two degree of freedom pendulum on an omnidirectional robot**

**Abstract:**

In this thesis a dynamical model for a two degree of freedom inverted pendulum on an omnidirectional cart. This system is actuated not only by the wheels on the cart but also by a quadrotor system being used to stabilize the inverted pendulum. The dynamic model is designed to be modular enough to re-parametrize the system as well as substitute different actuators and electrics and control algorithms. The parameters of this system are identified with procedures and background where necessary. This thesis presents two controller methods: PID and LQG controllers. The PID controllers were designed using both hand tuning and model based tuning. The LQG controller was designed using a systematic procedure to initially choose good weights and adjust the systems performance to get the most out of the system. Both sets of controllers are present along with a comparison of their behavior and plots comparing the real system to that of the non-linear simulation. The results of this design are discussed along with issues that shaped the design decisions are discussed and future work and systems improvements are discussed.