



جامعة الإمارات العربية المتحدة
United Arab Emirates University

**The College of Graduate Studies and the College of Engineering
Cordially Invite You to a**

Master Thesis Defense

Entitled

***An Evaluation of Two Controller Implementations for an Inverted Pendulum
on Cart System***

by

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Abstract: Various embedded systems are available for control system design and implementation in either lab experiments of postgraduate and undergraduate courses in the area of dynamics and control, or in experimental academic research. The focus of this Master thesis project is set to study, compare and evaluate the performance of two options of controller implementations ranging from a low-cost microcontroller based embedded system to a relatively high-end, high-cost controller prototyping system. In the work reported here, the Arduino® DUE board, which is an Atmel ARM Cortex CPU based, and the dSPACE® DS1104 prototyping system are used. Another objective of the thesis is also set to develop a testbed with challenging control. An inverted pendulum on a cart, driven by a DC motor

through a cable-pulley system, is developed and used. This classical control system is characterized as unstable, underactuated, nonlinear, and single-input-multi-output (SIMO) dynamic system.

The obtained results show that the performance of the Arduino DUE controller is nearly comparable to that of the dSPACE in most cases, and it even outperformed the dSPACE in some experiments. The results indicate that the Arduino DUE performance is in general more superior when considering stability and oscillations of the cart. The dSPACE performance on the other hand is better in responding to step inputs and in minimizing response time.

Keywords: control systems, inverted pendulum on cart, full state feedback, reduced order observer, integral action, Arduino, dSPACE.