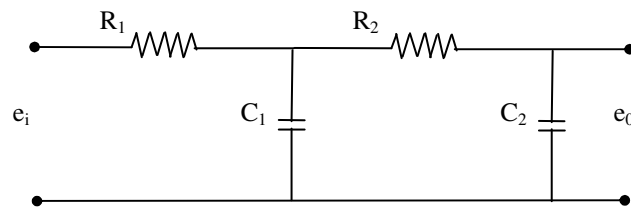# EE 554 – Midterm

Introduction

In Miniproject2 we have successfully simulated a second order system on the DE0/DE0 Nano FPGA. The second order system was accomplished by a 2-stage RC network, as shown in Figure 1.

Figure 1. A Second-order Electrical System

Description of the project

The objective of the Midterm project is to actually implement the circuit, and use the FPGA to implement a digital controller, and be able to control the voltage at the second capacitor, e_0, as shown in Figure 2. Further description of a similar system can be found in [1].
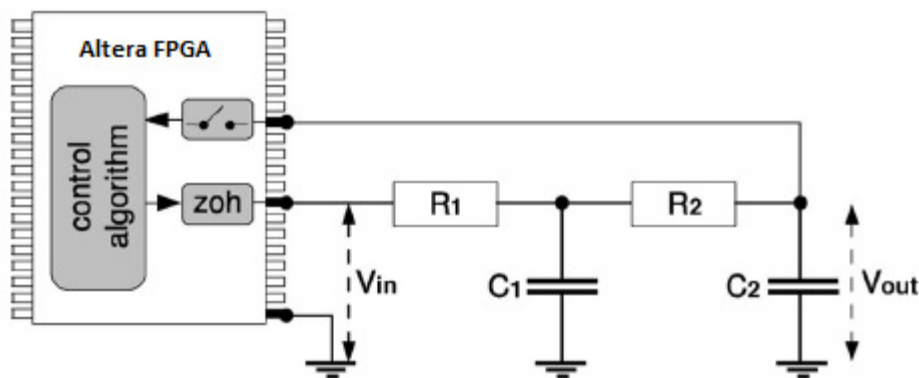
Figure 2. The closed-loop dynamic system

Requirements

Your team needs to demonstrate a working system for a square wave signal. The system should be able to track the input by using different gain values for the proportional controller and sampling frequencies, as per your design.

Find a good/best gain values for different input frequencies. For example, a specific high gain value may be appropriate for high input frequencies, but it may also produce large system overshoots, which is undesirable.

Documentation

You need to deliver a report that includes:
- A description of the controller design.
- MATLAB and C code, and plots of system simulation for the different parameters.
- Plots of the outputs of the system as seen on the scope.

This project will be graded as follows:
- **50% report.**
- **50% demonstration.**

References

[1] P. Marti, M. Velasco, J. M. Fuentes, A. Camacho, G. Buttazzo, "Design of an Embedded Control System Laboratory Experiment," *IEEE Transactions on Industrial Electronics*, Vol. 57, No. 10, October 2010.