California State University, Chico

MECA 482 – Control Systems

Group Project Proposal

Team:
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Description

Leveraging our Senior Capstone Project's problem, we are creating a mathematical model that will programmatically capture the temperature control system. Our project is being tasked with controlling the temperature of a 4" in length x 0.5" in diameter 316 Stainless Steel cylinder – this cylinder is used as a holding reservoir for samples used during experimentation. Initial conditions for the cylinder are standard laboratory conditions e.g. 24°C and 50% RH. The final condition for the cylinder is 4 +/- 0.25°C after 5 minutes i.e. must achieve an average -5°C/minute ramp rate.

Proposal

Our initial design concept includes the use of a Peltier thermo-electric cooler (TEC) – because of this we will assume this is our final hardware down select and use it for this project. The Peltier increases temperature based on amplitude and direction of current flow through its internals. Our mathematical model should be a closed loop single input single output (SISO) model, and can be seen below in figure 1. The shown model in MATLAB Simulink is being used as an example with the transfer function modeled being arbitrary.

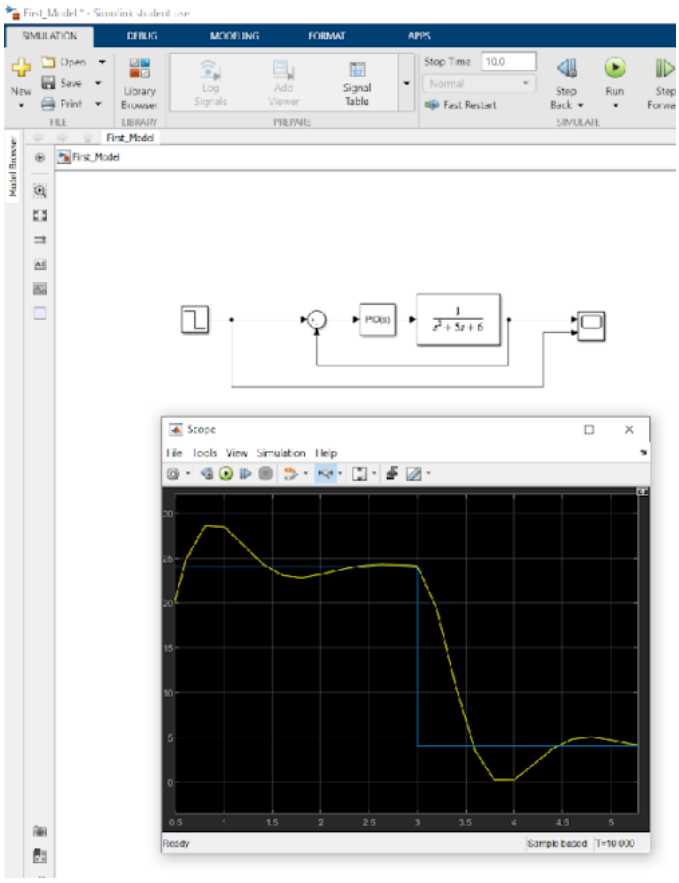


Figure 1. Arbitrary transfer function model of proposed system in MATLAB Simulink environment

System's High-Level Architecture:

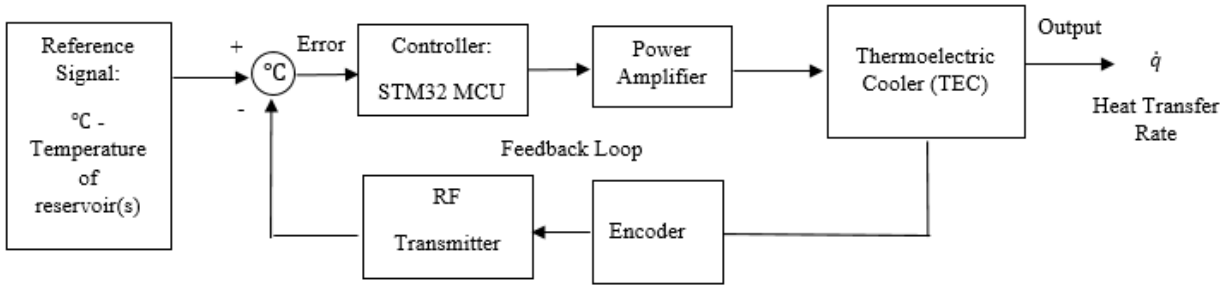


Figure 2. High-level architecture diagram for simulation use

Tasks required for completion

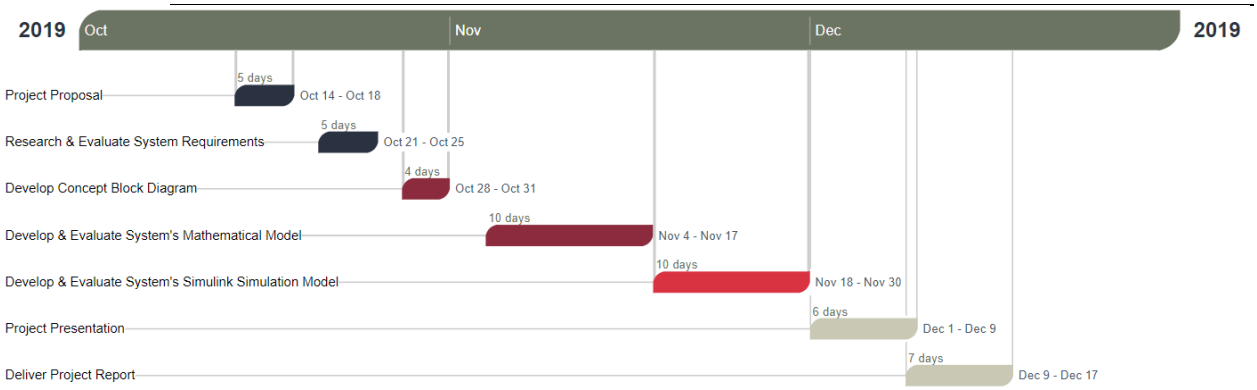
1. Create a mathematical model of the physical system
    a. Need material thermal coefficients and mass
    b. Need surface area of mass exposed to ambient air and model this as loss
    c. Need to understand the correlation between electrical current and its effect on temperature out/delivered
2. Create a PID controller in Simulink and tune the controllers Proportional, Integral, and Derivative values to achieve -5°C/minute ramp rate with overshoot equal to or less than +/- 0.25°C at target/commanded temperature setting.

Team and Plan:

Our team is comprised of the following members: Bryan Long (Section-01), Nate Hardesty (Section-03), Gene Santa Cruz (Section-03), and Alexis Hernandez (Section-03).

Role	**Responsibilities**	**Member**
Project Manager	Manages the project, decision making & project deliverables	Bryan Long
Control Systems Engineer	Creates, develops and executes mathematical model	Nate Hardesty
Mechanical Analysis Engineer	Research and analysis of heat transfer model for the system	Alexis Hernandez
Systems Test Engineer	Develop and execute MATLAB Simulink simulation model	Genaro Santa Cruz

Gantt Chart



References

Admin. “Types of Encoders and Decoders with Truth Tables & Applications.” *WatElectronics.com*, 26 Sept. 2019, www.watelectronics.com/encoders-and-decoders-truth-tables/.