

October 6th, 2023

To Whom It May Concern,

I was the lead instructor in an Online Research Seminar on Microcomputer Control of Electromechanical System organized by Path Academics, an education company in China. I am working with Path Academics as a Consultant. The purpose of this letter is to inform you of Jiacheng HUANG's performance in the Microcomputer Control of Electromechanical System program. This was an online program that involved 6 two-hour sessions with the instructor and regular meetings with the TA. The 7th session was for group presentations. There were 18 students attending. There were three assignments and a final group presentation. Students used online simulation and analysis tools: Falstad Circuit Simulator App; Autodesk's Tinkercad Microcontroller and Circuit Simulator; and Octave-online. The syllabus is below.

Session 1 (Jul 29, 2023):

- Derivation of the differential equation describing an RC circuit
- Introduction to the concept of a transfer function, using RC circuit as an example
- Frequency response of an RC circuit, using RC circuit as example
- Assignment: use Falstad Simulator to determine amplitude and phase shift of RC circuit tested at five specified frequencies

Session 2 (Aug 1, 2023):

- Derivation of the differential equation for a dc motor
- Transfer function for a dc motor, and compared with transfer function of RC circuit
- Derivation of gain for linear amplifier using op-amps
- Introduction to analog computer using op-amp circuits
- Assignment: develop using Falstad simulator, an analog computer to model a forced spring-mass-damper system

Session 3 (Aug 4, 2023):

- Transistor introduction using Falstad simulator for demonstration
- Feedback control - closing the loop around a plant having a known transfer function
- Derivation of the closed loop transfer function

Session 4 (Aug 9, 2023):

- Further discussion of how to determine closed loop transfer function using dc motor as an example
- Proportional speed control example using dc motor as plant and linear amplifier as controller
- Introduction of the Root Locus method using Octave online

- Discussion of position control and demonstration of Arduino controlled servomotor (using Tinkercad circuit simulator)

Session 5 (Aug 12, 2023):

- Closed loop position control of simulated dc motor using Falstad simulator
- Comparison with Octave-online analysis using the Root Locus and PZ Map commands
- Concept of poles and zeroes as a way to analyze linear dynamic systems
- Assignments for final presentations: easier one – implement analog computer using Tinkercad circuit simulator; harder one – use Octave-online to show how poles move when controller gain is varied for a closed loop around a dc motor with position as the output

Session 6 (Aug 15, 2023):

- PID control: proportional plus integral plus derivative control
- Discussion of stability and steady state error
- Interrupts for Arduino using incremental encoder as example

Review of course

Overall, Jiacheng HUANG's performance in this program was Good.

According to the TA, Jiacheng exhibited a strong commitment to his studies. He consistently attended all classes and tackled assignments with a positive attitude. Additionally, he actively engaged with the course material, and paid attention to the contributions of his peers. Jiacheng consistently submitted all assignments punctually, distinguishing himself with very good homework performance that ranked among the top in the class. His execution was methodical and his analyses were thorough, underscoring his comprehension of the subject matter.

Jiacheng, in collaboration with fellow students, jointly delivered a PowerPoint presentation and completed a good written report as part of their final project. His final project involved the analysis of PD control in motors utilizing Falstad, Tinkercad, and Octave. Within this framework, he assumed the responsibility of constructing a simulation circuit using Falstad, and determining the 'k' value for controlling Falstad based on the theoretical outcomes from his teammates' simulations, thereby achieving the desired waveform.

Sincerely,

A handwritten signature in blue ink, appearing to read "Michael Littman".

Michael Littman, PhD\*  
Consultant  
Path Academics

A handwritten signature in black ink, appearing to read "Hui Xu".

Hui Xu  
Senior Advisor, Academic Committee  
Path Academics

\*Dr. Littman is a Professor of Mechanical and Aerospace Engineering at Princeton University. Dr. Littman is working with Path as a Consultant.