PKU Globex Julmester

AI Enabled Control Engineering (3 Credits)

人工智能驱动的控制工程

(00333764)

Instructor	HUANG Xun (huangxun@pku.edu.cn) School of Mechanics and Engineering Science, Peking University	
Synopsis	Introduce the fundamentals of control theories to undergraduates in Engineering. Graduate students in dynamics and control are also welcomed if their undergraduate trainings were not in control. The pre-requisite course is calculus and linear algebra. Knowledge in electronic circuits and signal and processing will be helpful too, but will be summarized in this tutorial when it is necessary. In addition, the emerging machine learning-based control methods will be introduced, mainly through the successful completion of the designed software tasks. Hence, students are expected to have experience with Python or other similar programming language.	
Audience	Year 2 to 4 Undergraduate and Graduate Students. Students are encouraged to have a strong interest in building electronic and mechanical gadget and be willing to troubleshoot coding issues throughout the course. In addition, they should be able to quickly read through supplementary materials after each lecture, including sensor manuals and edge AI device documentation, to ensure that they are fully prepared for the following lectures.	
Classroom	TBA	
Schedule	Class: 9-12 AM, M-F, July 6- July 24, 2026	Total Contact Hours: 45
Objective	In this course, students will learn to model and analyze real-world problems from a control perspective, while also mastering fundamental modeling and control methods. Following this, they will be introduced to basic AI techniques, starting with a simulated environment and culminating in the development of a real inverted pendulum system. The first 7 lectures will be mathematic extensive, covering the fundamentals of control theory, and setting the stage for the more experiential learning approach in the final eight lectures. By completing this course, students are expected to gain extensive hands-on experience with sensors, actuators, edge AI hardware, and the associated control concepts and coding configurations. More importantly, they will learn how to integrate these components into a mechatronic system.	
Topics	1. Introduction 2. Mathematical model of system 3. Time domain analysis & control 4. Frequency domain analysis & control 5. Case study: dynamics & control of inverted pendulum 6. AI for control 7. Case study: Gym env and its AI-enabled control 8. State space 9. Observability & Controllability 10. Case study: classical control vs modern control vs AI-control 11. Exp1: Mechatronic of inverted pendulum (sensors, actuator, MCU, …) 12. Exp2: Classical control design for inverted pendulum	

	13. Exp3: AI tools for inverted pendulum (Jetson, Linux, …) 14. Exp4: AI enabled control of inverted pendulum 15. Competition of the control performance
Reference	Dorf R.C., Bishop R.H. Modern Control Systems, 12th edition. Lecture notes will be provided.
Grading	Homework problems 0% (Only for self-evaluation) Experiential learning report 50% Final exam 50% Total 100%

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Dr. HUANG Xun is a professor in Department of Aeronautics and Astronautics, School of Mechanics and Engineering Science, Peking University, and an adjunct professor in Department of Mechanical and Aerospace Engineering, HKUST. He earned his Ph.D. from Aeronautics and Astronautics, University of Southampton, United Kingdom. His research areas are aeroacoustics, flow control, flight control, and array signal processing. He has served as Associate Editor for Journal of the Acoustical Society of America and has published his research outcomes in prestigious journals such as Nature, Science Advances, and Progress in Aerospace Sciences.