

國立清華大學動力機械工程學系

2024 Spring Course:
Mobile Robots and Self-Driving Cars
移動機器人與自駕車

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Course Outline

This course gives an overview of mobile robots and self-driving cars **controlled** by an **artificial intelligence** system that makes movement decisions **autonomously** using a variety of sensing **data**. The AI system is introduced from **mathematical** (machine learning and classical planning), **physical** (control, actuation, and dynamics), **computational** (algorithms and software engineering), and **implemental** (coding and deployment) aspects. Machine learning includes **supervised** (**deep neural networks** for visionary data) and **unsupervised** (for radar data) **learning**. **AI-based control** and **dynamic theories** are the main focus of the course, which are emerging in robotics research. Project assignments aim at deploying students' **algorithms** to a Toyota **car** and a wheeled **robot** for real-world tests.

Course Contents

1. **Autonomous Operating (AI) System**
2. **Robotics Foundations**
3. **Vehicle Dynamics**
4. **Proportional–Integral–Derivative Controller**
5. **Kalman Filter**
6. **Model Predictive Control**
7. **AI-Based Control Algorithms**
8. **Course Projects: Autonomous Car and Wheeled Robot**

Prerequisite:

PME 543900 Introduction to Artificial Intelligence 人工智慧

Text Books: None. Lecture Notes with References:

Siciliano, B., et al. ed. (2008) *Springer handbook of robotics*, Springer.

Guiggiani, M. (2014) *The science of vehicle dynamics*, Springer.

Houska, B., et al. (2011) *ACADO toolkit—An open-source framework for automatic control and dynamic optimization*.

Grading Policy:

Course Projects and Presentations 100%

[生成式人工智慧倫理聲明](#) (有條件開放參考範例(1))

[Generative AI Ethical Guidelines](#) (Example 1: Conditionally open)

Demo Videos: [Car 1](#), [Car 2](#), [Car 3](#), [Robot](#)