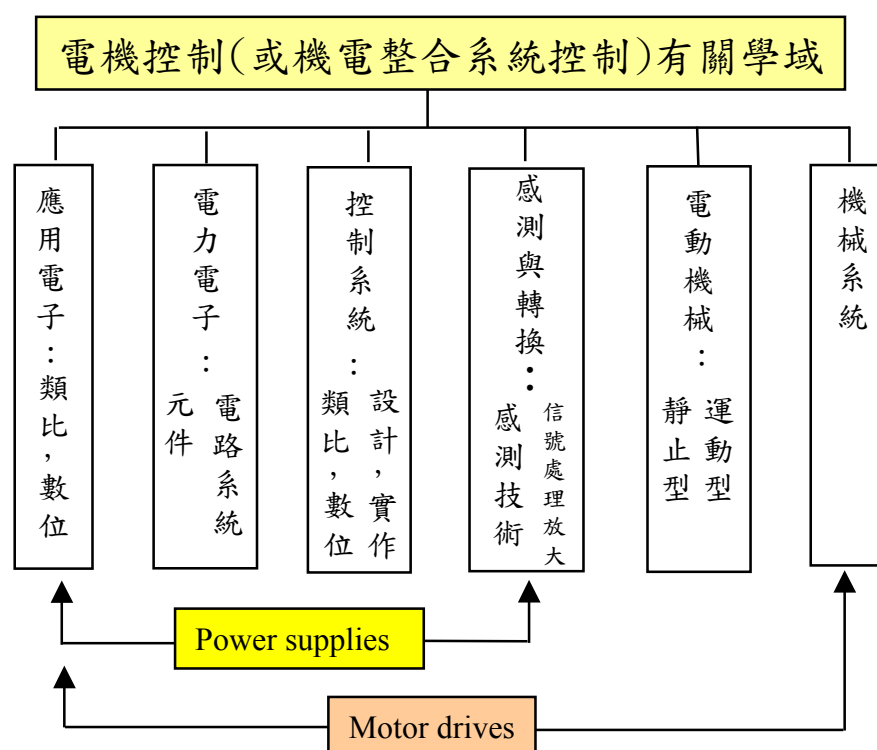


電機控制 (EE4840) 課前介紹

課程目的及內容：

目的： 介紹一個典型工業控制系統之操作實務，構建此系統必要組件之結構與工作原理。

所涉及領域：



內容： 如所列。

教材： 原則上由任課老師提供講義。

考核方式： 作業、考試。

實驗： 視實際需要及時間儘量提供。

Electric Machine Control (EE4840) (C. M. Liaw)

Contents

- Introduction to electric machine control.
- Overview of power semiconductor devices.
- Introduction to motor drives and their applications.
- Dynamic and static specifications of sensors.
- Sensors and transducers.
- Signal conditioning circuits for sensors and transducers.
- V/I, I/V, F/V, V/F, A/D, D/A converters.
- Shielding and grounding of power electronic systems.
- Analog controllers.
- Digital controllers.
- Power converters.
- DC motor drives (converter-fed and chopper-fed)
- AC motor drives:
 - Modulation techniques and harmonic analysis.*
 - Inverters (DC-AC converters).*
 - Induction motor drives.*
 - Synchronous motor drives (Brushless DC Motor (BDCM) drives).*
- Experiments (solid-state motor control).

Text book:

- 講義
- Timothy J. Maloney, *Modern industrial electronics*, 5th Ed., Pearson Prentice Hall, 2004.

Reference books:

- R. Krishnan, *Electric motor drives: modeling, analysis and control*, Prentice Hall, 2001.
- J. M. Jacob, *Industrial control electronics*.
- J. M. Jacob, *Power electronics: principles and applications*, Delmar Thomson Learning, 2002.
- G. K. Dubey, *Power semiconductor controlled drives*, Alpha Science, UK, 2001.
- Sergey E. Lyshevski, *Electromechanical systems, electric machines and applied mechatronics*, CRC Press, 2000.
- Ned Mohan et al., *Power Electronics: Converters, Applications and Design*, 3rd Ed., John Wiley & Sons, Inc., 2003.
- P. C. Sen, *Thyristor DC Drives*.
- B. K. Bose, *Modern Power Electronics and AC Drives*, Prentice Hall PTR, New Jersey, 2002.
- Robert W. Erickson and Dragan Maksimovic, *Fundamentals of Power Electronics*, 2nd Ed., Kluwer Academic Publishers, 2001.
- Others

The diagram illustrates a motor control system architecture, divided into two main sections: the **Control section (弱電)** and the **Power section (強電)**.

Control section (弱電):

- Software (軟體) (microprocessor):** Manages the overall control logic, including the **Position feedback loop (位置迴授)** and the **Speed feedback loop (速度迴授)**.
- Hardware (硬體) (customized LSI circuits):** Implements the **Current feedback loop (電流迴授)**.
- Control Flow:** The system starts with a **位置命令** (Position command). This is compared with the **位置** (Position) feedback to generate an error signal for the **Position controller**. The output of the position controller is a **速度命令** (Speed command), which is compared with the **速度** (Speed) feedback to generate an error signal for the **Speed controller**. The output of the speed controller is a **電流命令** (Current command), which is compared with the **電流** (Current) feedback to generate an error signal for the **Current controller**. The output of the current controller is fed into the **Open-loop control (Switching control)**.

Power section (強電):

- Power converter:** Receives the switching control signal and converts it into a three-phase output (P, V, I) for the motor.
- Motor:** The motor's mechanical parameters are J_{Motor} (Inertia constant) and B_{Motor} (Damping ratio). It is coupled to the mechanical load.
- Mechanical load:** The load has parameters T_{Load} (Load torque), B_{Load} (Damping ratio), and J_{Load} (Inertia constant).
- Isolation and driving:** The motor is driven through an **Optocoupler or transformer** for isolation.

Position and Speed Feedback:

- The **位置感測器** (Position sensor) provides the **位置** (Position) feedback signal to the position feedback loop.
- The **速度感測器** (Speed sensor) provides the **速度** (Speed) feedback signal to the speed feedback loop.

有關控制策略:

- 估測迴授變數避免使用感測元件 (sensorless)
- 多迴路迴授 (multi-loop control)
- 數位控制 (digital control)
- 框轉換及解耦控制 (向量控制) (transformation and decoupling control)
- 系統參數估測 (parameter identification)
- 適應控制 (adaptive control)
- 最佳控制 (optimal control)
- 韌性控制 (robust control)
- 智慧控制 (intelligent control)

功率半導體元件

電源 (DC, AC)

(DC or AC)

負載

(變壓、整流、濾波、功因控制、湧浪電流抑制)

觸發驅動電路

隔離電路 (變壓器、光隔離器)

控制命令信號

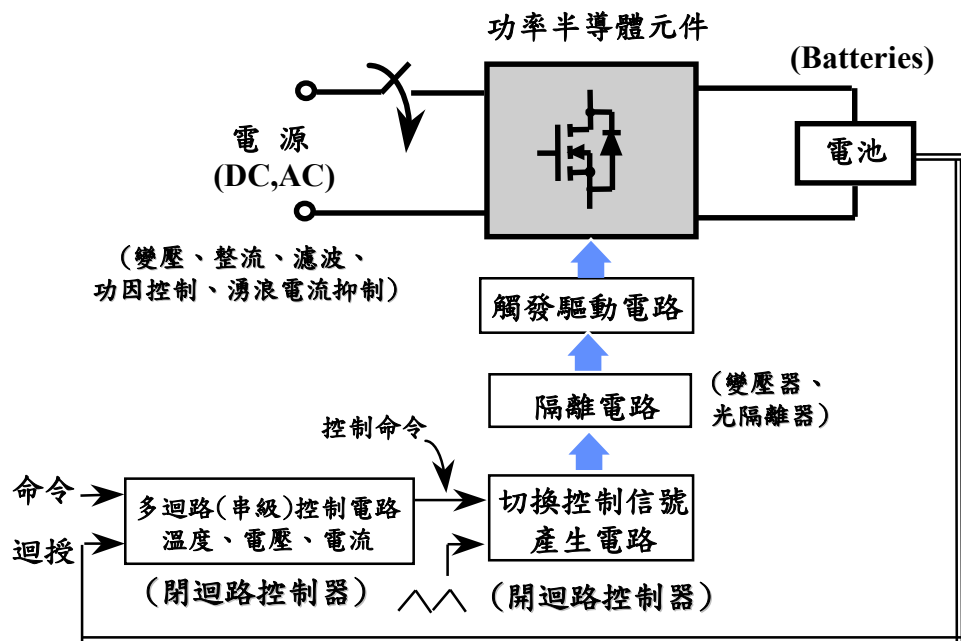
多迴路(串級)控制電路
位移、速度、電流
(閉迴路控制器)

切換控制信號產生電路
(開迴路控制器)

命令

回饋

電池充電電路基本組成



電池系統研發有關學域

