

Power Screws and Bolted Connections

ME4020 - Applied Machine Design

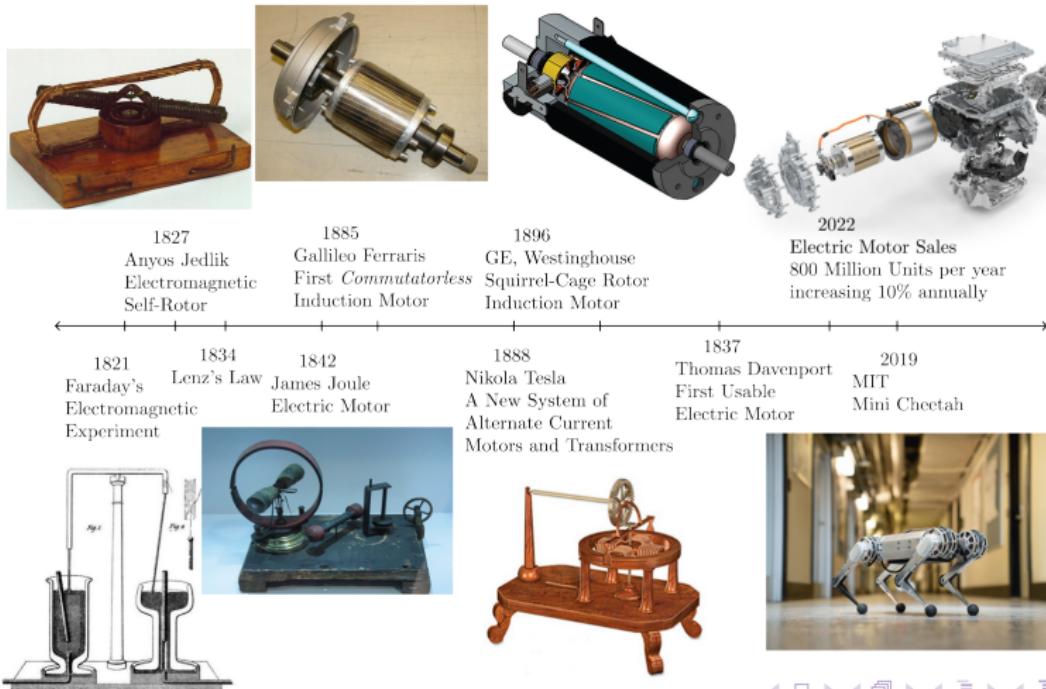
Mechanical Engineering
Tennessee Technological University

Motor Selection

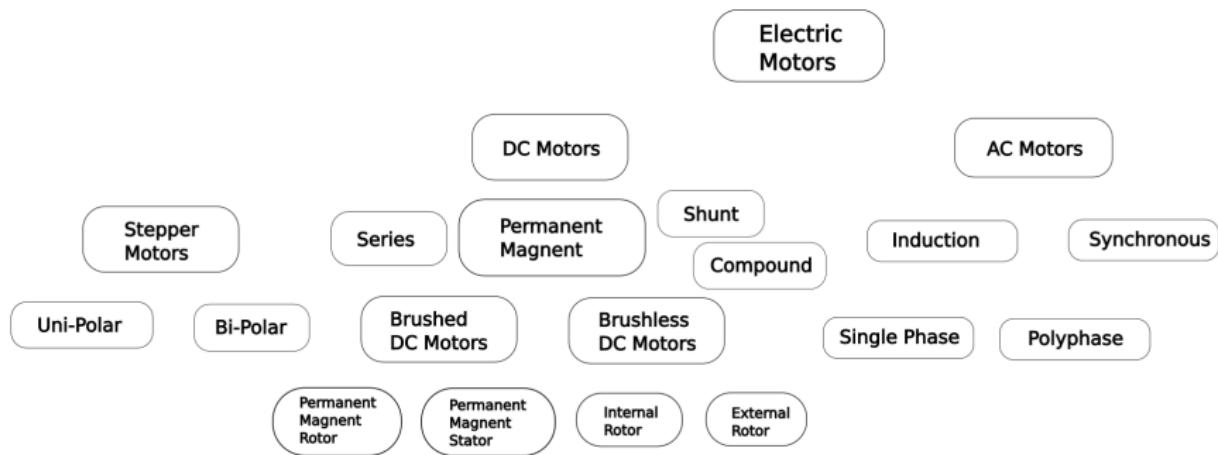
Motor Selection

- Overview and Classification
- Open Loop and Closed Loop Control
- Motor Torque-Speed Curves
- Motor Driver/Controller
- Analysis and Selection

Overview and Classification

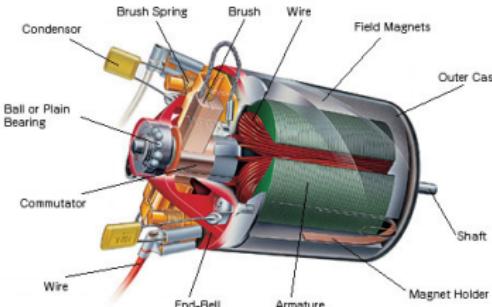


Overview and Classification



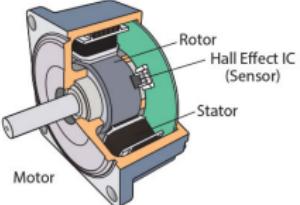
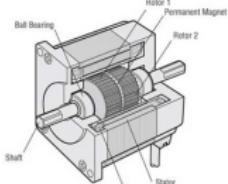
Overview and Classification

Common Electric Motor Types

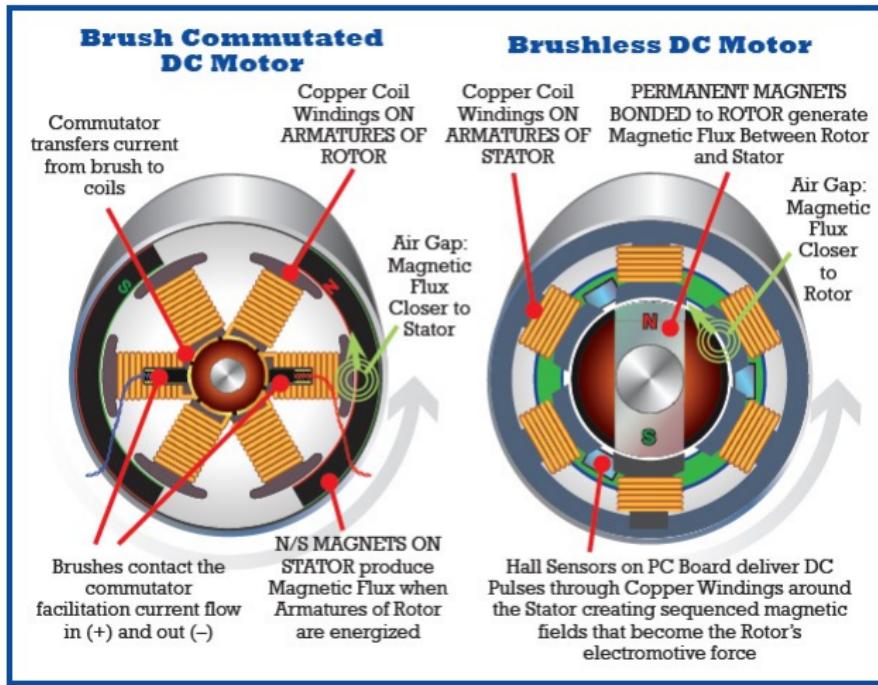
— Type —	— Example —	— Application —
		
		

Overview and Classification

Common Electric Motor Types (cont.)

— Type —	— Example —	— Applications —
		
	 <small>Motor Structural Diagram: Cross-Section Parallel to Shaft</small>	

Overview and Classification



Open Loop and Closed Loop Control

Open Loop Control

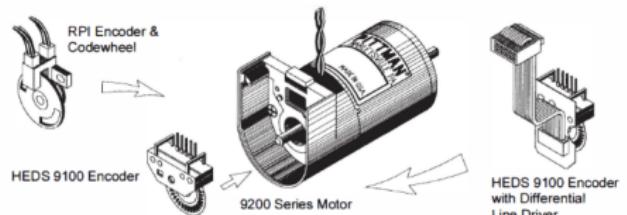
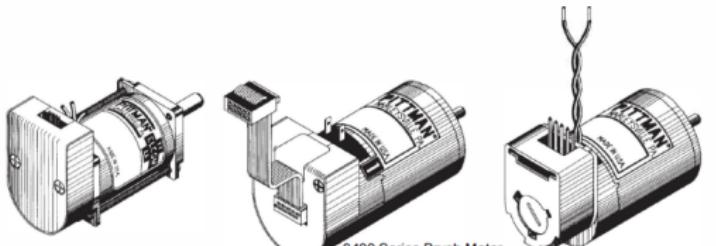
- aka feed-forward controller
- sensorless operation

Closed Loop Control

- aka feedback control
- Bang-Bang Control
- Current, Velocity, Position Control
- Preferred Strategy: PID
(alternatives: Model Predictive, Fuzzy Logic)

Open Loop and Closed Loop Control

Feedback Controlled Brushed DC Electric Motor



Open Loop and Closed Loop Control

Feedback Controlled Brushless DC Electric Motor
Modern Case Study: Universal Robotics - Cobot Arm Joint

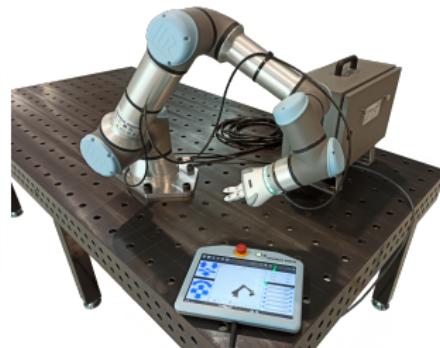


image: [wikimedia commons](#)

Open Loop and Closed Loop Control

Open-Loop Control

Applications:

-
-
-

Pros

-
-
-

Cons

-
-
-

Open Loop and Closed Loop Control

Closed-Loop Control

Applications:

-
-
-

Pros

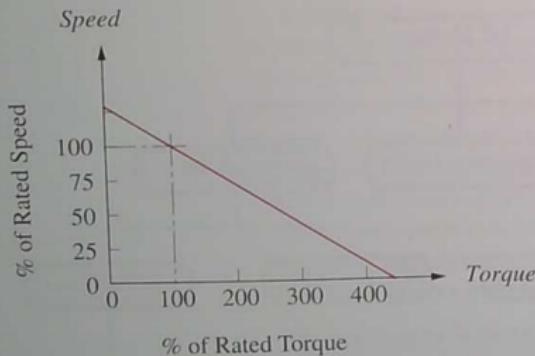
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Cons

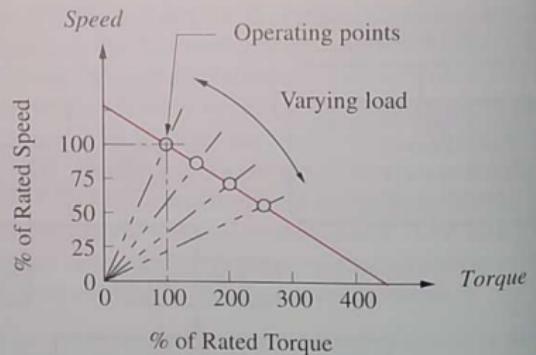
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Open Loop and Closed Loop Control

Motor Torque-Speed Curves

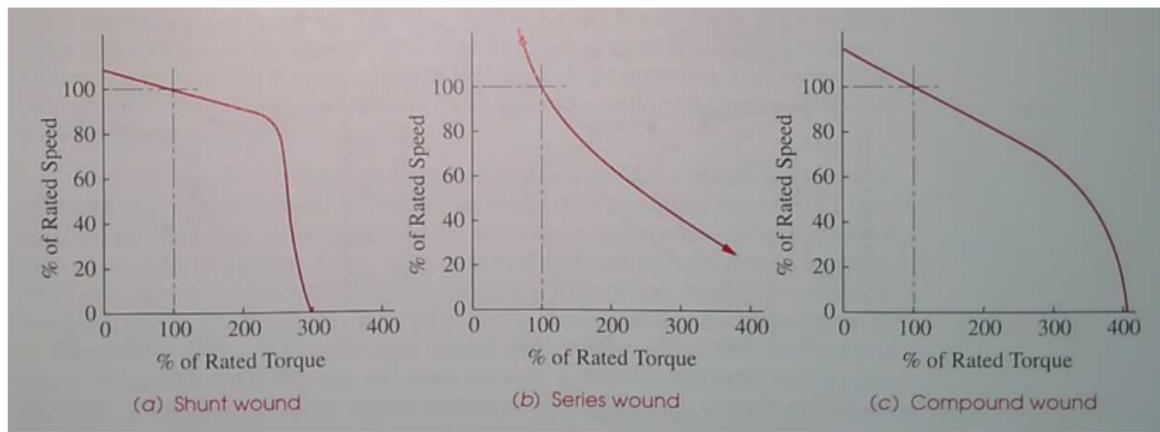


(a) Speed-torque characteristic of a PM electric motor



(b) Load lines superposed on speed-torque curve

Motor Torque-Speed Curves



Motor Torque-Speed Curves

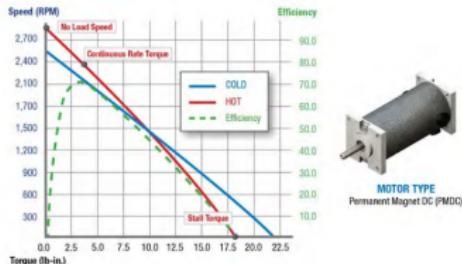


Figure 7: Speed, Torque, Efficiency Curves of a PMDC motor

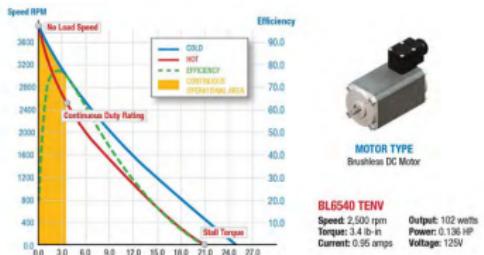


Figure 10: Speed, Torque, Efficiency Curves of a BLDC motor

duty rating



Figure 9: Speed, Torque & Efficiency Curves of an AC Induction Motor

Motor Driver/Controller

A motor driver, aka controller, is required to operate an electric motor.

- low-level -> high-level, high-end
- open-loop, close-loop
- various signal inputs (e.g. analog, PWM, Serial, USB, etc)
- dip switches + potentiometer configured -
- computer configuration and user interface
- feedback control integration

Analysis and Selection

Considerations for Motor Selection:

- What are the torque requirements?
- What are the speed requirements?
- Does the application require a feedback control?
- What type of motor driver or controller is required?
- Does the form factor of the motor fit in the machine?

Analysis and Selection

Haydon Kerk Pittman Ametek - Brushed DC

Haydon Kerk Pittman Ametek - Brushless DC