

# Power Screws and Bolted Connections

ME4020 - Applied Machine Design

Mechanical Engineering

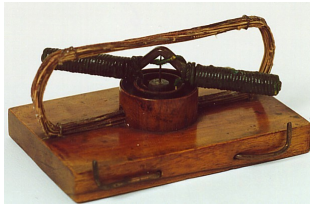
Tennessee Technological University

## Motor Selection

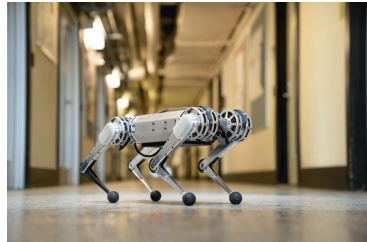
## Motor Selection

- Classification of Electric Motors
- Open Loop and Closed Loop Control
- Motor Torque-Speed Curves
- Analysis and Selection

# Classification of Electric Motors

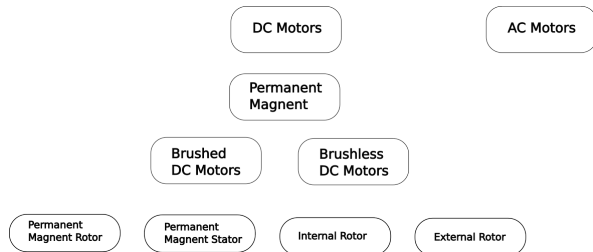


Jedlik's Electromagnetic Self-Rotor




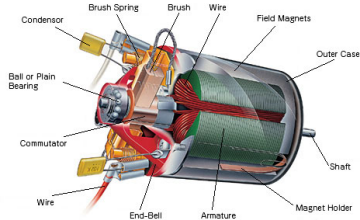
MIT Mini Cheetah

# Classification of Electric Motors



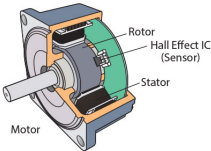
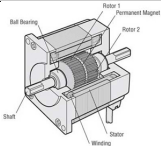
# Classification of Electric Motors

## Common Electric Motor Types

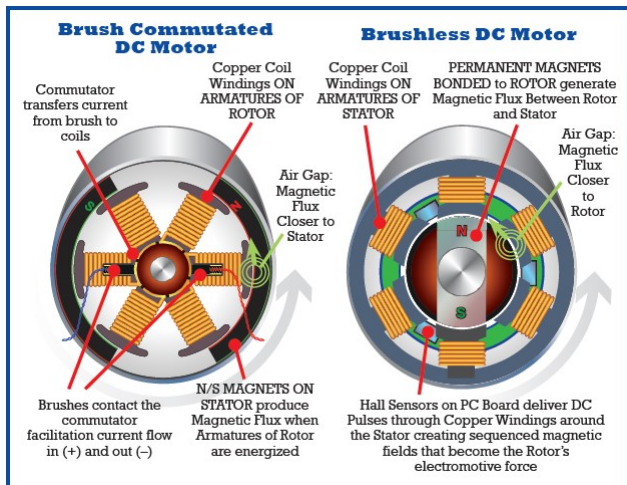
— Type —	— Example —	— Application —
		
		

# Classification of Electric Motors

## Common Electric Motor Types

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

# Classification of Electric Motors



# Open Loop and Closed Loop Control

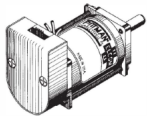
## Open Loop vs Closed Loop Control

- Open Loop Control
- Bang-Bang Control
- Armature Control
- Position Control
- Velocity Control

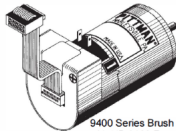


# Open Loop and Closed Loop Control

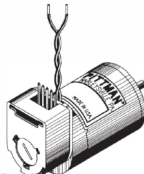
## Feedback Controlled Brushed DC Electric Motor



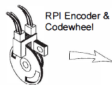
3400 Series Brushless Motor  
with HP 9100 Encoder



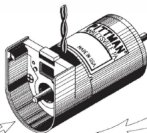
9400 Series Brush Motor  
with HP 9100 Encoder and  
Differential Line Driver



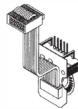
9200 Series Brush Motor  
with HP 5500 Encoder



HEDS 9100 Encoder



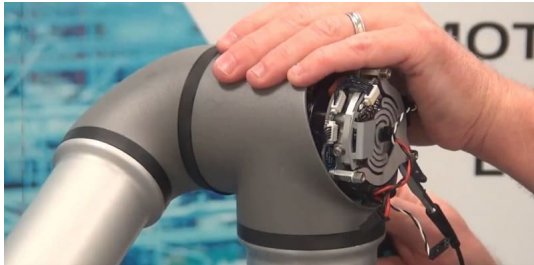
9200 Series Motor



HEDS 9100 Encoder  
with Differential  
Line Driver

# Open Loop and Closed Loop Control

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



# Open Loop and Closed Loop Control

Applications:

- 
- 
- 

Pros

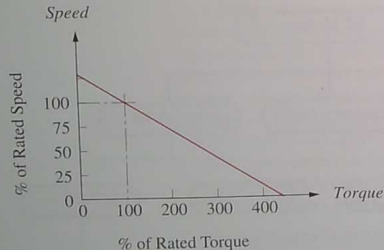
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Cons

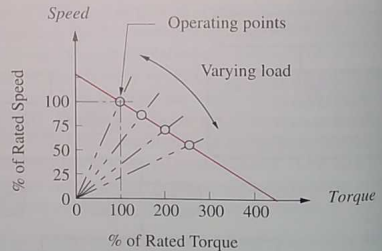
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# Open Loop and Closed Loop Control

# Motor Torque-Speed Curves

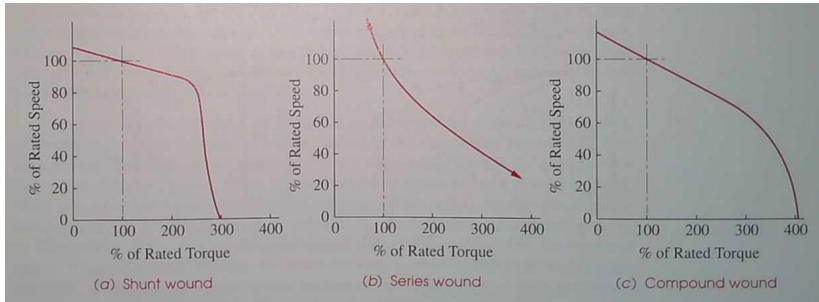


(a) Speed-torque characteristic of a PM electric motor



(b) Load lines superposed on speed-torque curve

# Motor Torque-Speed Curves



# 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