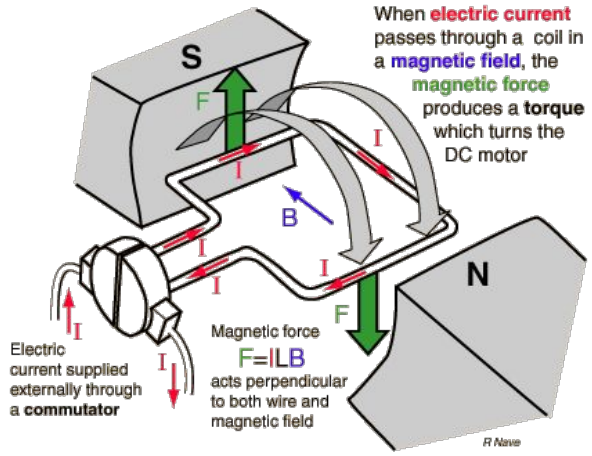
Carnegie Mellon ROBOTICS CLUB

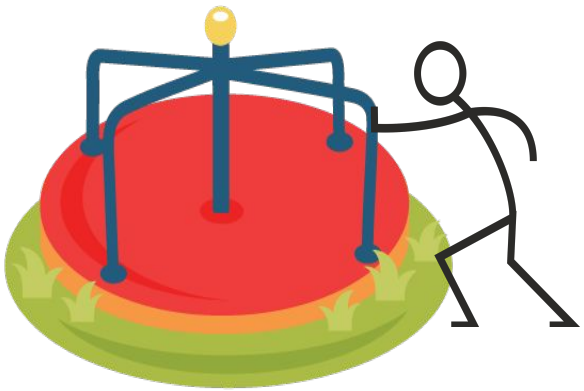
Today in Robotics: Actuation: Different Types of Motors

Fall 2026

Review for Motors:

- In a motor, the electric current results in a magnetic field.
- In conjunction with permanent magnets, makes the motor shaft turn.
- The most basic motor type is the brushed DC motor.



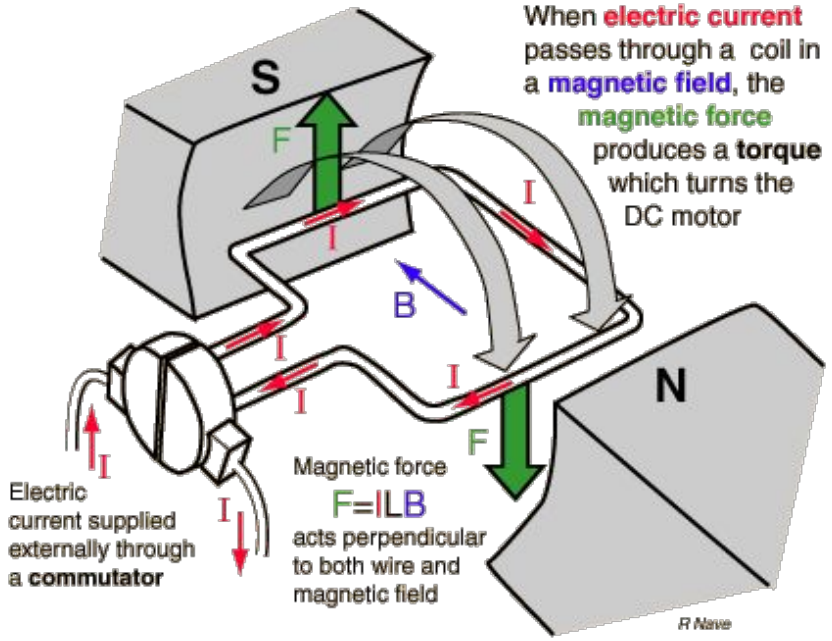


Carnegie Mellon ROBOTICS CLUB

Candy Time!

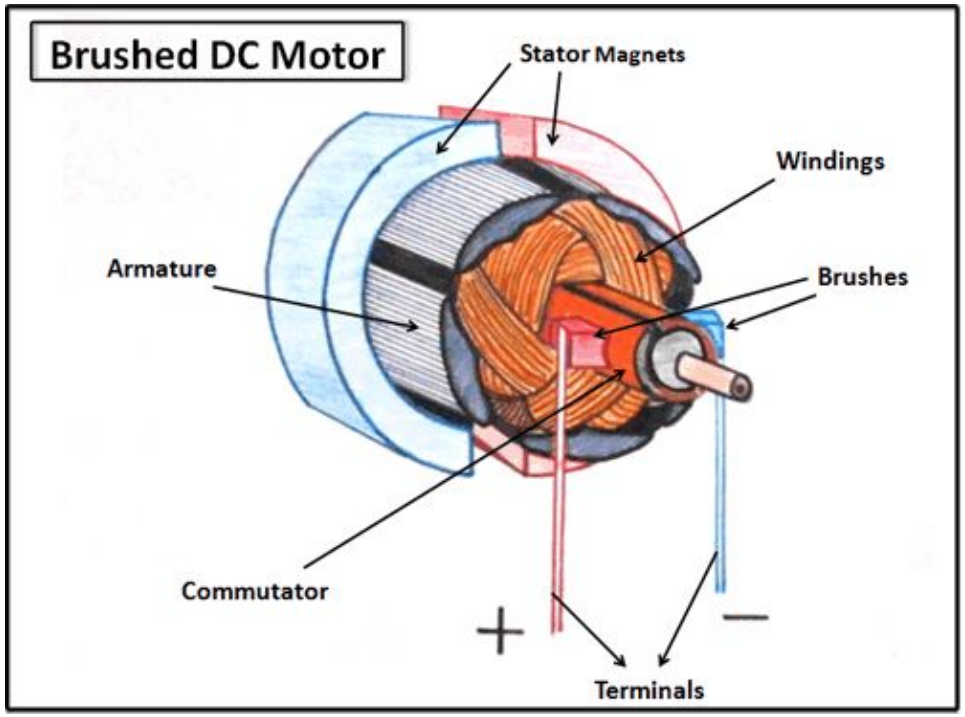
When, as the motor spins, does the current switch polarity?

When the loop is 90 degrees from its starting position in this picture (when the wire of the loop is perpendicular to the magnetic field.



Motors: Brushed DC

- Temporary magnetic fields interact with permanent magnets to make the motor spin.
- Requires commutation and brushes
  - Mechanical rather than electrical solution



Carnegie Mellon ROBOTICS CLUB

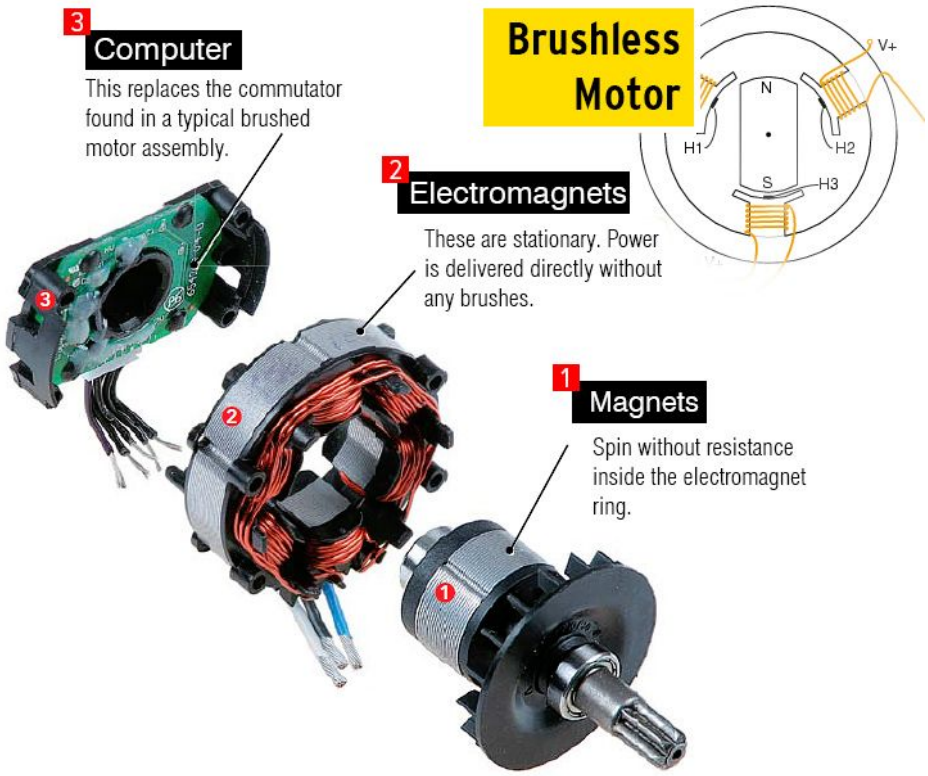
More Types of Motors!



Carnegie Mellon ROBOTICS CLUB

Actuators: Motors: Brushless DC

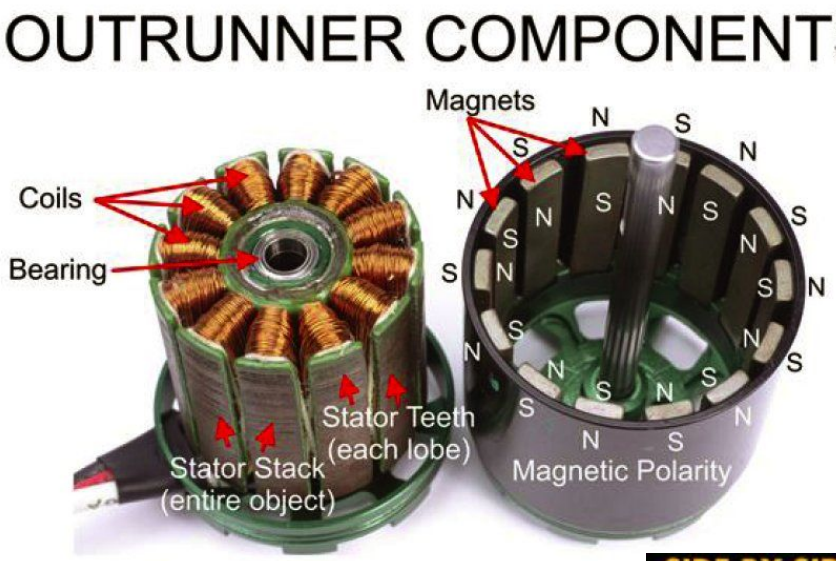
- No commutator/brushes
- Requires commutated control



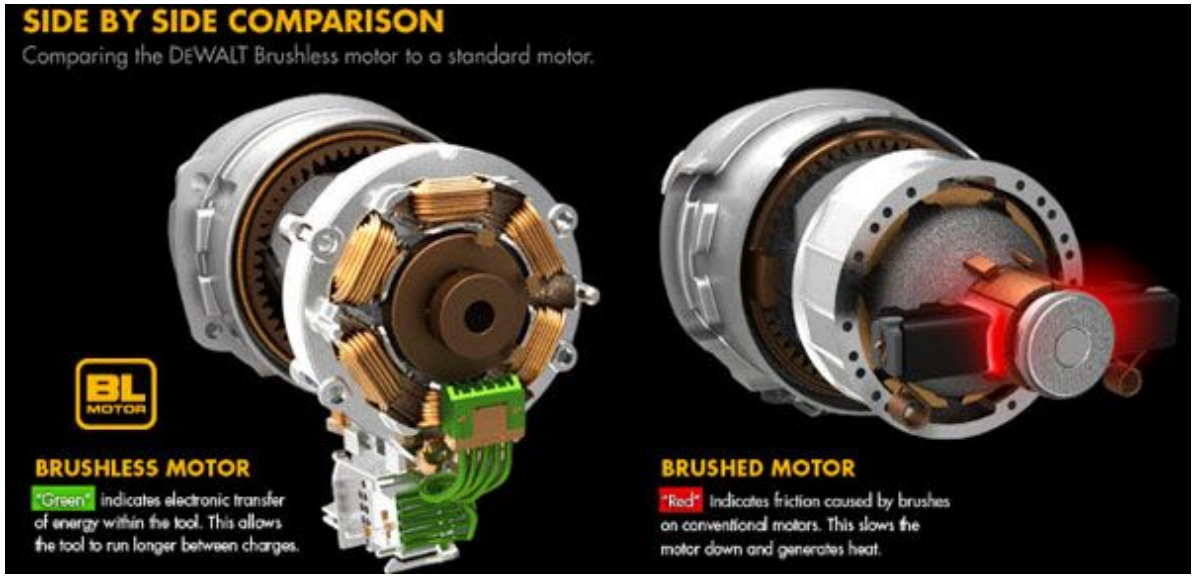


Carnegie Mellon ROBOTICS CLUB

Actuators: Motors: Brushless DC



- Electrical rather than mechanical
- Control the currents through a chip rather than through brushes.



Actuators: Motors: Brushless DC

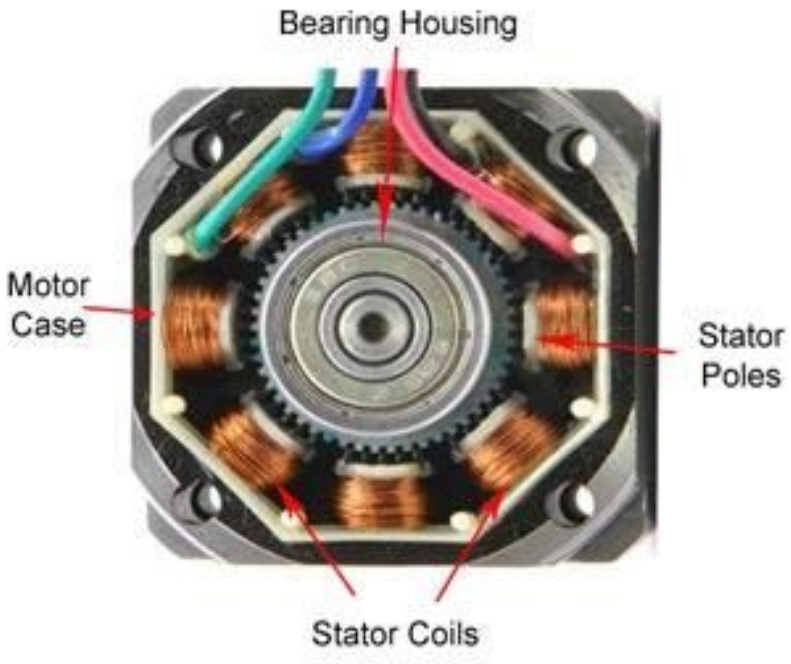
- Popular in hobby industry
- Fast + relatively powerful
- Speed ~ Voltage
- No brushes to wear out, long life
- High efficiency

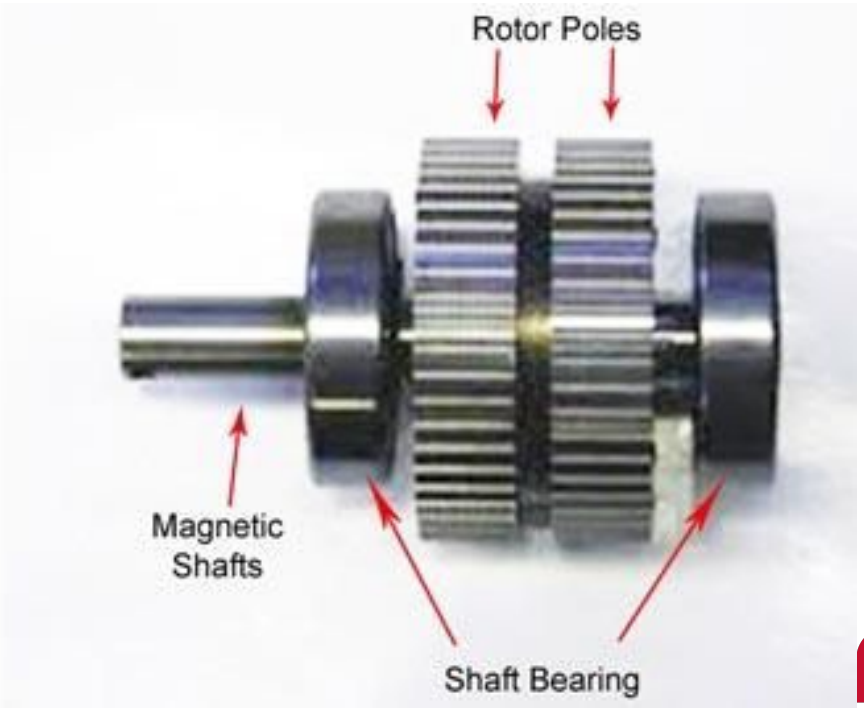


Carnegie Mellon ROBOTICS CLUB

Actuators: Motors: Stepper

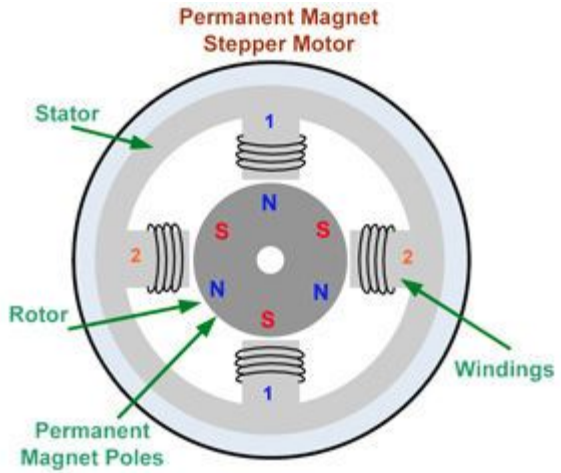
- Turn in steps
- Used for fine open-loop position control
- Very exact and very strong

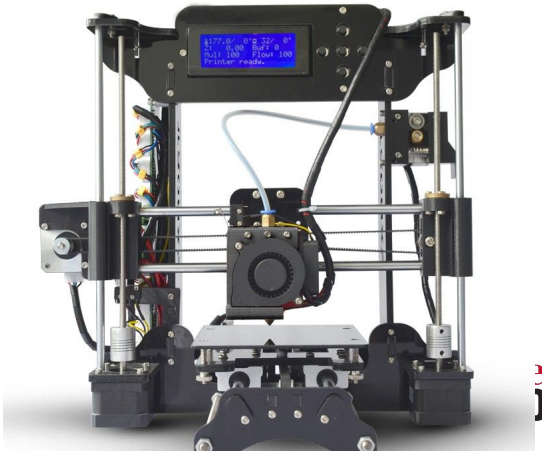




Actuators: Motors: Stepper

- Permanent magnets are on the gear teeth and shaft.
- Turn on certain coils to make the shaft turn to a specific position.
- Benefits
  - No gearing necessary!
  - Know exactly how far you can go





egie Mellon
OTICS CLUB

Regular Versus Stepper Motors

- Brushed and brushless motors: before the coil reaches the permanent magnet, the next step is already energized.
- Stepper motors: the coil reaches the permanent magnet, and then the next step is energized.

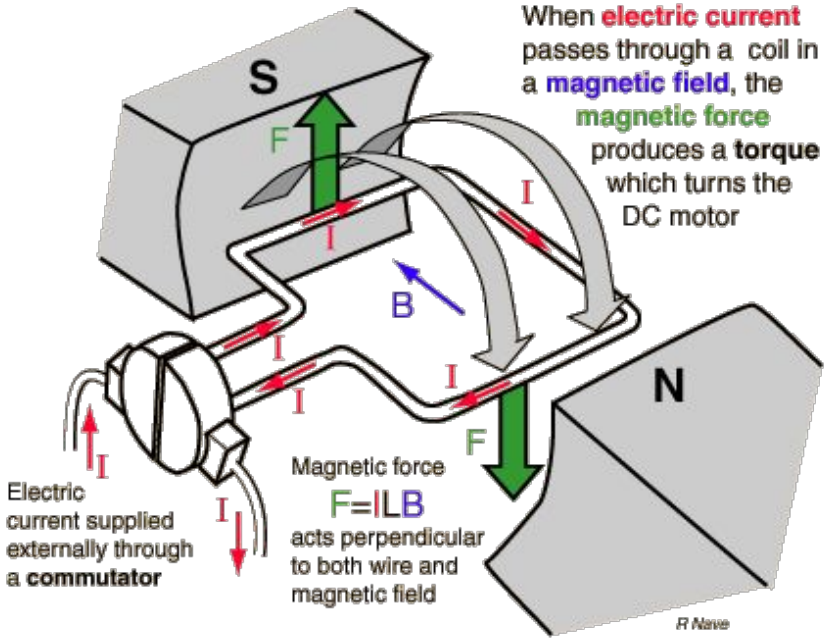


Carnegie Mellon ROBOTICS CLUB

Candy Time!

Why are stepper motors more powerful than other motors?

Stepper motor magnets can be more powerful because the loop can stop at every “tick.” If the same motors were applied in a regular motor, the loop get stuck at the magnets, even after the coil was reversed.



Carnegie Mellon ROBOTICS CLUB