

# Design Lab: Actuation Systems

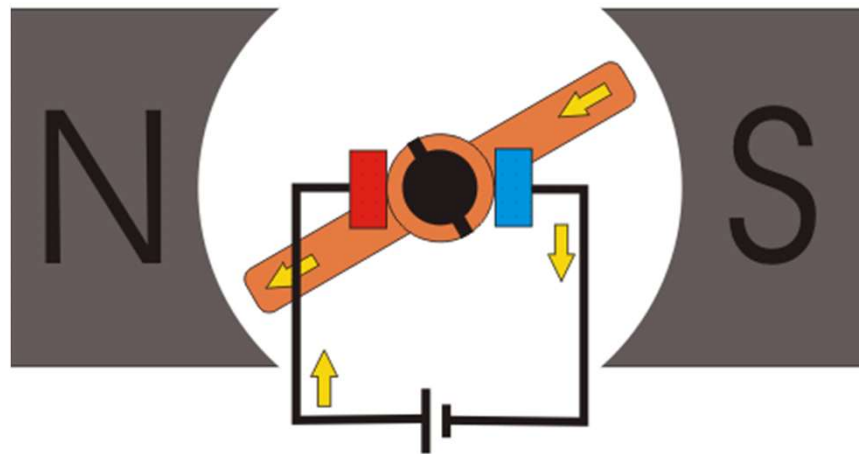
Corso Materiali intelligenti e Biomimetici  
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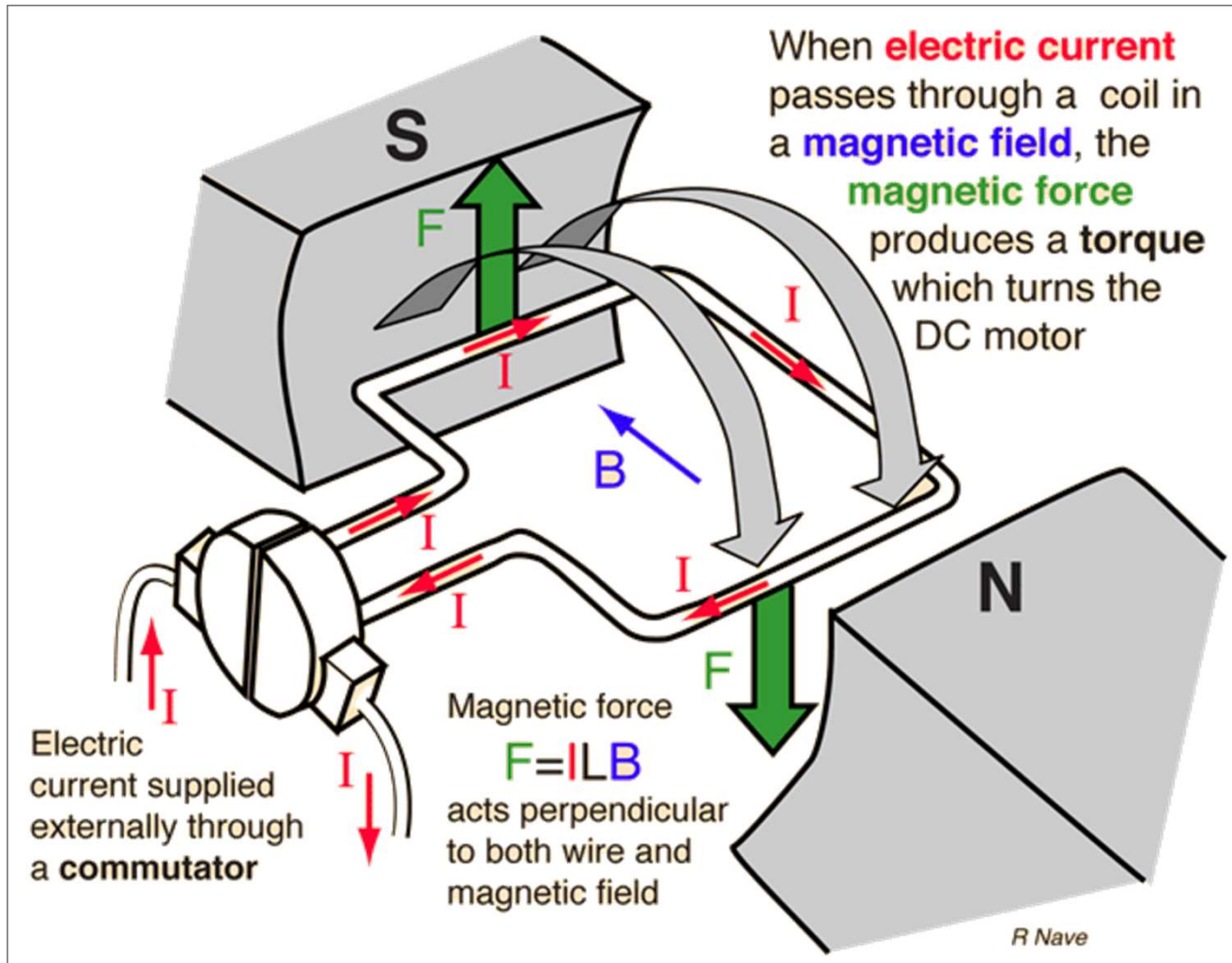
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# Motors

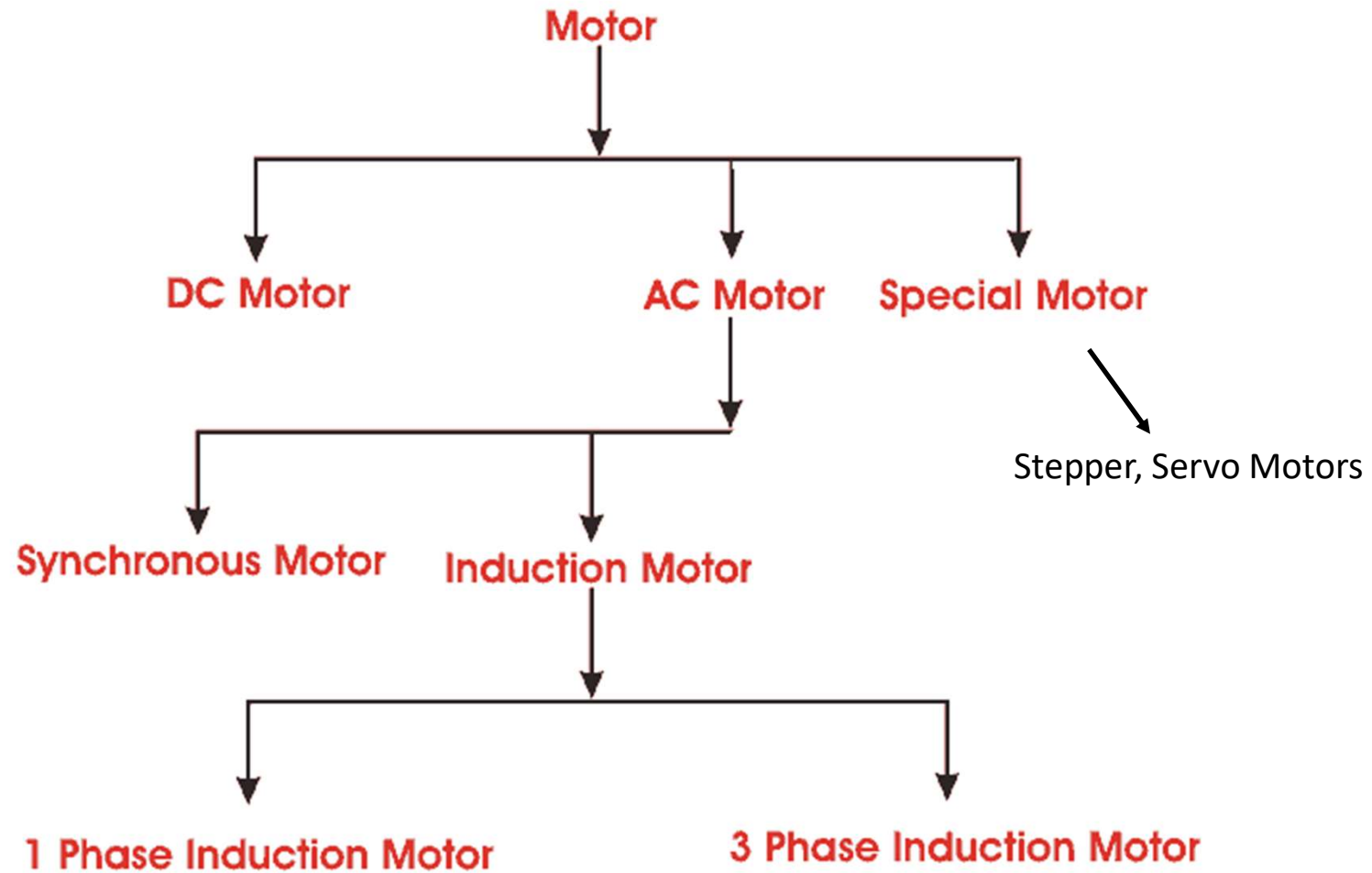
A motor is an **electro-mechanical device** that **converts electrical energy to mechanical energy**.

The very basic principal of functioning of an electrical motor lies on the fact *that force is experienced in the direction perpendicular to magnetic field and the current*, when field and current are made to interact with each other.





# Types of Motors



# Stepper

A stepper motor is a **type of DC motor that rotates in steps.**

When electrical signal is applied to it, the motor rotates in steps:

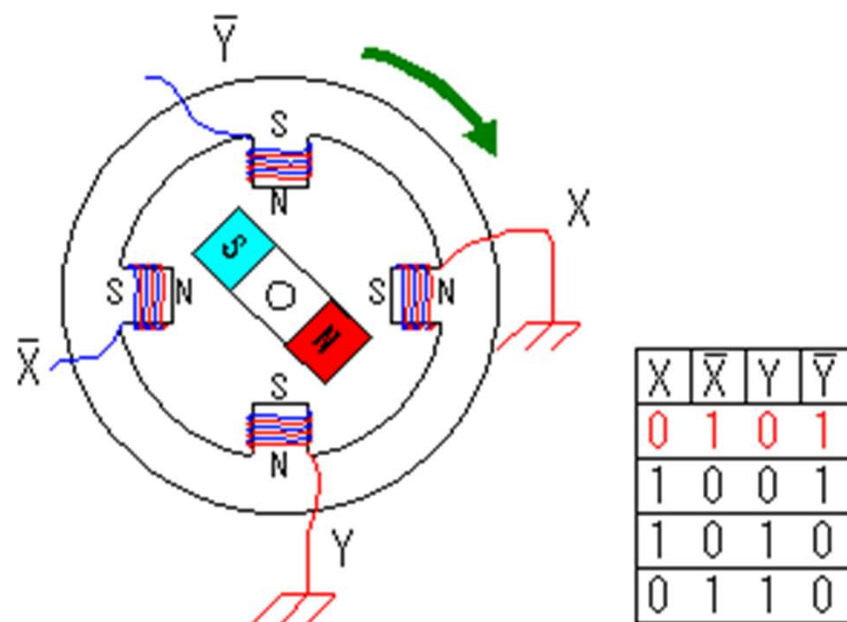
- The **speed of rotation** depends on the *rate at which the electrical signals are applied*;
- The **direction of rotation** is dependent on the *pattern of pulses* that is followed.

A stepper motor is made up of a **rotor**, which is normally a *permanent magnet*. A **stator** is another part which is in the form of *winding*.

The magnetic property of the stator changes and it will selectively attract and repel the rotor, thereby resulting in a stepping motion for the motor.

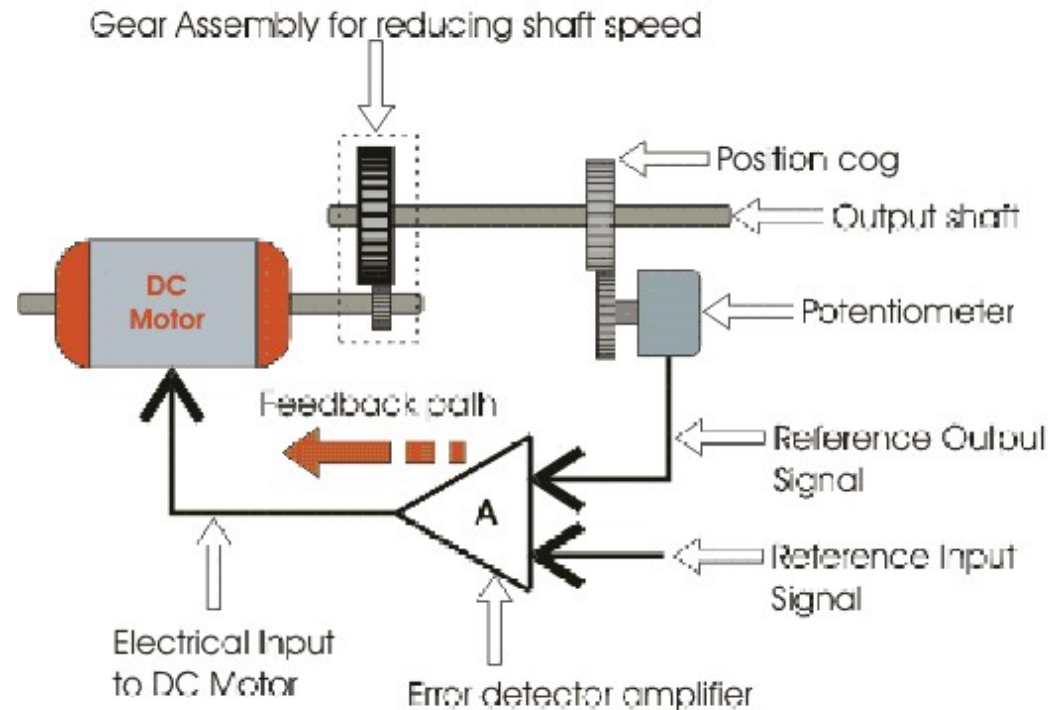
In order to get correct motion of the motor, a **stepping sequence** has to be followed. This stepping sequence gives the *voltage that must be applied to the stator phase*.

Normally a 4 step sequence is followed. When the sequence is followed from step 1 to 4, we get a **clock wise rotation** and when it is followed from step 4 to 1, we get a **counter clockwise rotation**.



# Types of Motor 4 - Servo

A servo system mainly consists of a **small DC motor**, a **potentiometer**, **gear arrangement** and a **feedback system**.



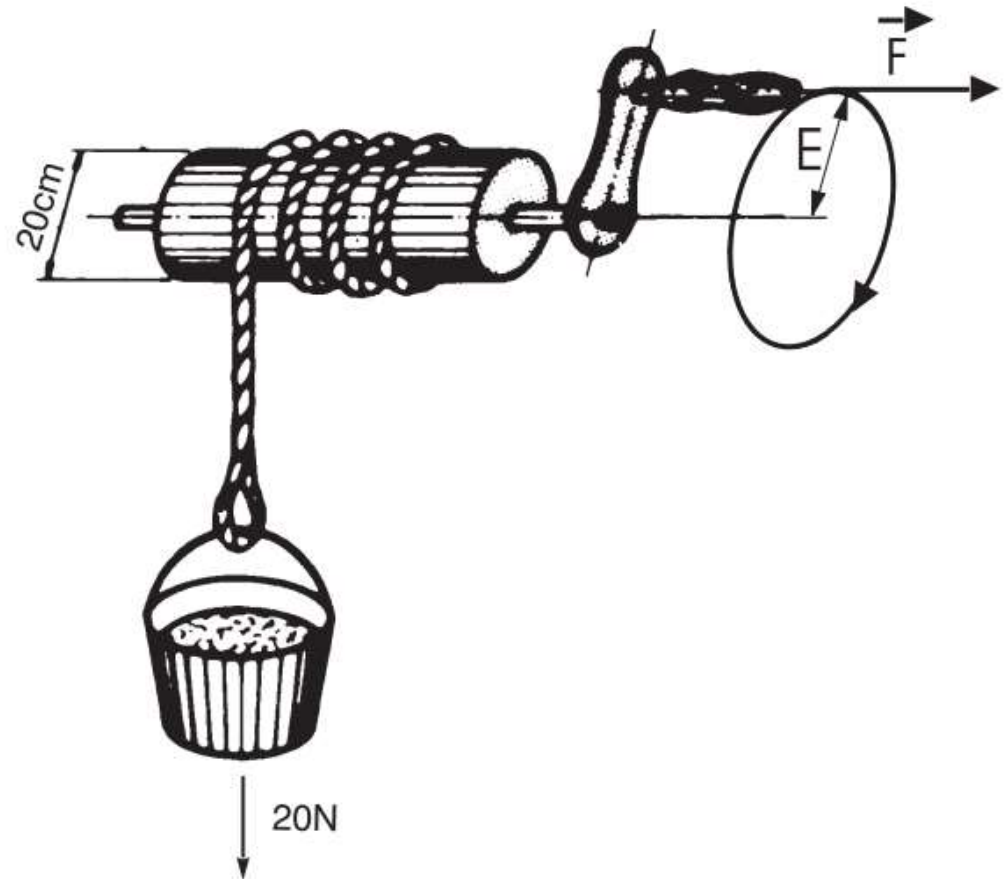
- The device is controlled by a feedback signal generated by comparing output signal and reference input signal. Hence, the primary task of a servomechanism is to **maintain the output of a system at the desired value** in the presence of disturbances.
- *During rotation of the shaft, the knob of the potentiometer also rotates and creates an **varying electrical potential that is taken to the error detector feedback amplifier** along with the input reference commands i.e. input signal voltage.*
- The gear mechanism is used to **step down the high rpm of the motor shaft to low rpm at the output shaft** of the servo system (small DC motor will rotate with high speed but the torque generated by its rotation will not be enough to move even a light load).

# Motor torque & Power

$$T = F * E$$

$$P = W / t$$

$$P = T * \omega [\text{rad/s}]$$



# Esercitazione 2

- Calcolare la coppia motrice e potenza necessaria per l'applicazione
- Ricerca motore idoneo all'applicazione: evidenziare 2-3 motori (tipo, marca & modello, fornitore & codice fornitore) allegando i relativi datasheet e riassumendo in una tabella le proprietà