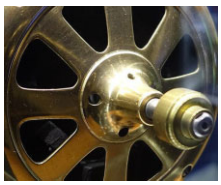
Courtesy U.S. Department of Interior

Chapter 12

Motors, sensors, and electrical circuits



*Mot*ivating *mot*ors (see examples in Hw 8)

Complete the association with an English word that contains the Latin ***mot*** (move).

Note: Answers to these interactive questions are at www.MotionGenesis.com ⇒ Textbooks ⇒ Resources.

Word	Definition
Motion	$\vec{\mathbf{F}} = m\vec{\mathbf{a}}$ is an equation that governs this.
Motivate	Encourage, e.g., a carrot or a stick.
Motown	Diana Ross' record label (Detroit).
Motrin	Aspirin-like painkiller to help arthritic people move around.
Motility	Measure of the speed at which food passes through the digestive system.
Lomotil	Antidiarrhetic drug that literally translates to low motility.
Emotion	Powerful feelings, e.g., love, hope, fear, joy.
Demotion	What happens to an engineer who mistakenly uses $\vec{\mathbf{T}} = I\vec{\boldsymbol{\alpha}}$ for 3D rotational motion.
Comotion	Hubbub or fracas.
Locomotion	Changing (moving) location (hint: root locus and trains)
Promotion	Climbing a rung on the career ladder. Hint: knowing the golden rule for vector differentiation.
Motor	The Latin word for "mover" (or "to move").

Summary

There are a variety of reasons to study motors, sensors, and electrical circuits:[1]

- Motors actuate mechanical systems and generators create electrical power.
- Many sensors (e.g., accelerometers, proximity sensors) are ***electromechanical systems***.[2]
- Circuits help shape signals from sensors and to motors/actuators.

This chapter uses ***KCL (Kirchoff current law)***[3] to analyze circuits in the time domain (the independent variable is time t).[4] The dependent variables are ***current*** (i) and ***voltage*** (v). Resistors, inductors, and capacitors are modeled as ***linear***, meaning current and voltage are related by a ***linear*** (algebraic or differential) equation and a resistor (R) or inductor (L) or capacitor (C) constant.

The following table summarizes resistors, inductors, capacitors, and DC (direct current) permanent magnet motors. Each element is shown with a representative picture and symbol and an equation that relates **current *i* through the circuit element** to **voltage *v* across the circuit element**.

[1] Motors have many applications including computer hard-drives, DVD drives, toothbrushes, cell phone vibrators, Microwave/oven rotators, car starter motors, air-conditioner/refrigerator compressors, water pumps, etc.

[2] An ***electromechanical system*** is one that has both mechanical and electrical components.

[3] ***KCL (Kirchoff current law)*** can be easier to use and understand than ***KVL (Kirchoff voltage law)***.

[4] Some engineers prefer to do circuit analysis using Laplace transforms with an independent variable s. The Laplace transform is particularly helpful for investigating steady-state response (transients in circuits are frequently very short duration).