DC motor and battery

Two common DC circuit elements are batteries and DC motors. We will model each.

DC motors

DC motors exert a torque $T = K_t i$ (where K_t is the torque motor constant and i is the motor current) on a rotational mechanical load.

A motor's armature is typically a wire coil through which current flows. A magnetic field is applied such that the coil rotates due to its magnetic field interaction (called the Lorentz force).

The resistor R and inductor L account for the armature's resistance + inductance.

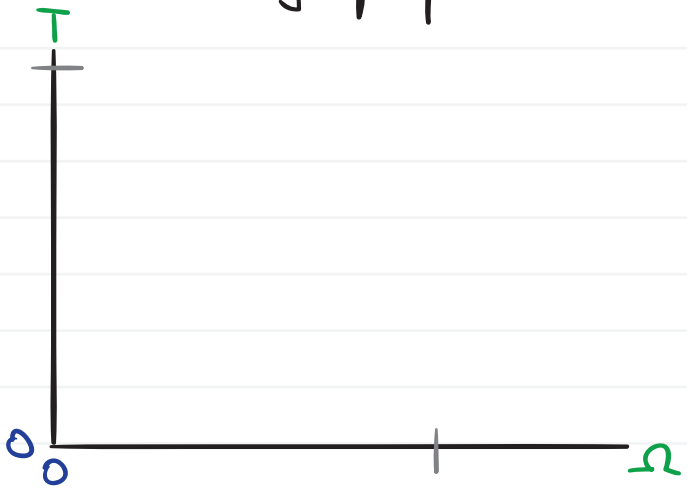
The mysterious voltage source v_{cemf} is called the counter-emf or back-emf. As the motor speeds up, Faraday's Law predicts

a voltage will be generated in opposition to the original (no velocity) voltage. This behavior is that which makes a motor behave as a generator.

The motor constants K_t + K_v are usually provided by the manufacturer of the motor.

Assuming steady-state operation (i.e. DC current applied), we can ignore the inductance L. The current i is of primary importance to us so we compute it:

This relationship predicts the familiar result that motor torque and speed are inversely proportional



Batteries

A battery can be modeled as an ideal voltage source in series with a resistor.

The battery's internal resistance yields the output voltages:

no load :

load :