# 1 Background Theory and Experimental Methods

## 1.1 DC Motor Systems Modeling



Figure 1: DC Brush Motor Electro-mechanical model

The electro-mechanical model of a DC brush motor is shown in **figure 1**. The electrical circuit takes an input voltage and generates a voltage drop across the rotor. The electrical energy from the voltage drop can be related to the resulting angular velocity, , through the motor velocity constant, :

(Equation 1)

The current of the circuit, , can also be coupled to the resulting torque in the motor,, through the back-EMF constant, :

(Equation 2)

Performing electrical and mechanical analysis on the system using equations 1 and 2 leads to the following transfer function relating the output angular velocity to the input voltage:

(Equation 3)

Equation 3 is typically written in the following format for ease of identifying the system parameters, system gain, , and time constant, :

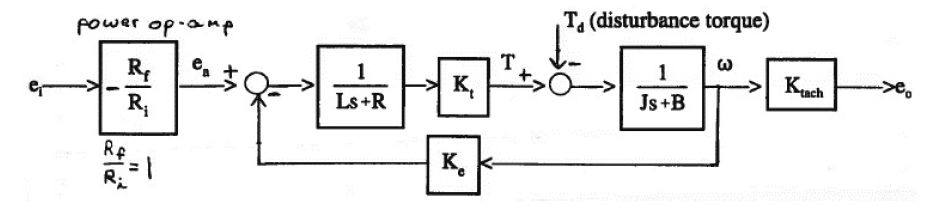
Therefore, the equations for the system gain and time constant of a motor are:

(Equation 5)

(Equation 4)

The detailed derivation steps for the motor transfer function are attached in Appendix A1.1 in this document.





Transfer function with disturbance torque:

Relating output to disturbance torque: