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Title: DC Motor Speed Control using PI Controller

***Abstract*:** Due to shortcomings of low accuracy and response lag in various methods of the DC motor speed control, a comparison between different methods of DC motor speed control will be carried out. The Proportional Integral (PI) controller design and selection of various Proportional, Integral control parameters according to various system responses is built in this model. MATLAB is a multi-paradigm numerical computing environment and proprietary programming language. It allows matrix manipulations, plotting of functions and data, implementation of algorithms. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems. Simulink has been used to implement the Proportional Integral (PID) controller that can be used to control the speed of DC motor and bring it at the desired speed.

Introduction:

The reason to control the speed of the engine is to conquer the issue in the industry like to maintain a strategic distance from machines harms and to stay away from the moderate ascent time and high overshoot. The PI controllers always have been broadly utilized for control of speed in dc engine. In all strategies the speed is controlled by monitoring the armature voltage, armature present, terminal voltage and by control-ling the field current of dc engine.

Theory:

Subsystems :

1. **PI controller subsystem**: The Discrete PID controller is used to measure the Speed, Torque and Voltage of the DC motor and then send it back as feedback. The PI estimation relies on two parameters which is known as the corresponding, the indispensable and subordinate part which is called P, and I part. P decides the response to current blunder, I decides response to the aggregate of as of late showed up blunders. The aggregate of each of the two sections contribute the control instrument, for example, speed control of an engine in which P esteem relies on current mistake, I on the gathering of past mistake. PI controller will analyze the error signal between measured speed and desired speed and this error signal is used to calculate the voltage required to command the motor. The error constants that the PI helps in rectifying are named as Kp and Ki .
2. **DC Motor subsystem**: A common actuator in control systems is the DC motor. It directly provides rotary motion and, coupled with wheels or drums and cables, can provide translational motion.

   The physical parameters for model are:

   1. (J) moment of inertia of the rotor 0.01 kg.m^2
   2. (b) motor viscous friction constant 0.1 N.m.s
   3. (Ke) electromotive force constant 0.01 V/rad/sec
   4. (Kt) motor torque constant 0.01 N.m/Amp

5. (R) electric resistance 1 Ohm
6. (L) electric inductance 0.5 H

3. A**nalog to Digital Converter**: Analog-to-digital conversion is an electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal. Analog to Digital Converter samples the analog signal on each falling or rising edge of sample clock. In each cycle, the ADC gets of the analog signal, measures and converts it into a digital value and since the control system used in model is digital there is also modelling of A-D converter .

Matlab Blocks:

1. **Data inspector:** The Simulation Data Inspector visualizes and compares multiple kinds of data. Using the Simulation Data Inspector, Actual Speed and Desired speed is inspected and compared in the model.

2. **Callback**: A callback is a function that executes in response to some predefined user action, such as clicking on a graphics object or closing a figure window. Associate a callback with a specific user action by assigning a function to the callback property for that user action. Callback function is used in the model for declaring variables using Postload function
3. **Lookup Table:** A lookup table is an array of data that maps input values to output values, thereby approximating a mathematical function. Given a set of input values, a lookup operation retrieves the corresponding output values from the table.
4. **Matlab Function:** With a MATLAB Function block, we can write a MATLAB function for use in a Simulink model. The MATLAB function helps in execution for simulation and generates code for a Simulink Code target. Matlab function is used to build Pulse generator in the model.
5. **Signal Builder:** The Signal Builder block allows you to create interchangeable groups of piecewise linear signal sources and use them in a model. You can quickly switch the signal groups into and out of a model to facilitate testing. Signal builder block is used to build desired speed subsystem which is having two step inputs.
6. **Solver Selection Strategy**: Ode45 is used in the model built as the system is Nonstiff type.

Results:

The results of the model built indicates that obtained speeds and the desired speeds are evaluated using PI controller technique .Various matlab functions and blocks are used in the model for obtaining desired outcome.

Model: