Analytical study for stepper motor control using Kalman filter
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Abstract:

The goal of this thesis is to estimate the state of permanent magnet stepper motor (PMSM). The system is highly nonlinear and one therefore cannot directly use any linear system tools for estimation. However, if one can linearize the system around a nominal operating point (possibly time-varying) then linear system tools could be used for control and estimation. Firstly, the error covariance matrices of measurement and process would be derived when the system inputs and outputs are subjected to uncertain variation. Then, the corrupted noise nonlinear model will be discretized and extended to be suitable for applying standard discrete Kalman filter for state purpose.

The entire state estimated system has been modeled using MATLAB program, and the state estimation algorithm and the motor discretized model are coded inside special S-function of m-file type, also we study the open loop control and close loop control using PID controller for PM Stepper Motor.

We study also the linearity limitations and how we linearize a nonlinear systems to estimate its state, we use a mathematical tools called Taylor series expansion.

We study also the measurement noise and process noise and detection and shielding of noise in stepper motor systems.