VerilogA: Motor Model

Three Phase Brushless Motor

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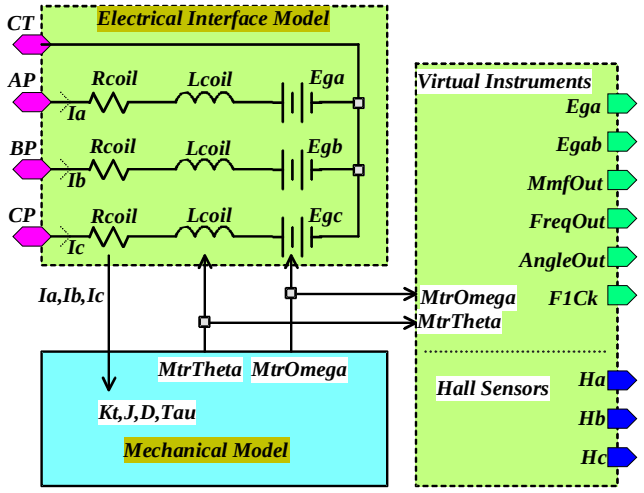
Description

This Verilog-A model emulates a Y connected 12 pole, 3 phase brushless motor and is designed for use in Hard Disk Drive spindle motor control simulations. The model includes phase inductance vs rotor angle for rotor position sense(RPS) applications development. Virtual instruments for position and velocity are include as system de-bugging aids. Virtual hall sensor are implemented.

Block Diagram



Features

- Torque Derived for torque vs position accuracy
- Grey coded Hall Sensor Outputs 36 states per revolution
- Stiction/Running Torque Modeled
- Coil Inductance vs angle and current for RPS apps.

Pin Description

Physical Pins

1. A – A motor Pin
2. B – B Motor Pin
3. C – C Motor Pin
4. Ct – Motor Center Tap

…. Positive Current is pin -> Ct

Motor Model State Variables

1. MtrTheta = Rotor Angle
2. MtrOmega=Rotor Frequency

Support Pins

1. Ha,Hb,Hc – Virtual Hall sensor outputs

… 1.0v Asserted; 0v de-asserted

Measurement Pins

1. Ega – Back Emf V{A,Ct}
2. Egab Back Emf of V{A,V}
3. MmfOut – Motor Torque{1v=1N-m}
4. FreqOut – Motor Frequency{1v=1hz}
5. AnlgeOut – Motor Angle{1v=10 degrees}
6. F1Ck – Motor “once per rev” clock

… 0<AngleOut<180 => 1.0v else 0v

Model Parameters

Kt – Motor Torque Constant{Nm/A}
.. note Ke{v/(r/s)} = Kt
J – Motor Moment of Inertial{
D – Motor Torque loss vs frequency
Rcoil – Resistance of each phase
Lcoil – Inductance of each phase
IcoilSat – Coil Current where inductance is reduced 50% when magnetic fields are aligned
TauStop – Friction when Motor Stopped
TauRunning – Friction when motor Running

MtrOmega0 – Motor Frequency @ Time=0
MtrTheta0 – Motor Angle @ Time=0

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