

## **MODELLING, ANALYSIS, COMPARATIVE STUDY AND DYNAMIC RESPONSE OF STEPPER MOTOR**

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### **Abstract**

This paper presents results of magnetic circuit analysis of Permanent Magnet Hybrid (PMH) and Variable reluctance (VR) stepper motors by permeance model. The variation of torque under steady state with variations of exiting current and number of turns is explained in permeance model. Maximum torque of PMH and VR motors are compared under steady state condition. This paper also presents the comparison and analysis of cogging torque and core losses of Permanent Magnet hybrid (PMH) stepping motor made up of laminated steel core with claw pole (PM) motor made up of soft magnetic composite core. The material used as Permanent Magnet in both the machines is NdFeB. Basic analysis was done using equivalent magnetic circuit for both machines and refined analysis is carried on Claw Pole (PM) machine using finite element magnetic field analysis. Cogging torque is found to be double in claw pole machine than that of PMH machine. Core losses are more at normal frequencies and reduced to one-third at higher frequencies for soft magnetic core PM. This paper also describes about the effect of mid-frequency response on the dynamic behavior of permanent magnet stepper motor (PMH). State space model of stepper motor characterized by state equations is used for dynamic analysis of the stepper motor. The case study analysis revealed that for particular speeds, motor is unstable at mid-frequency range of operation.

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**Keywords:** Permanent magnet hybrid stepping motor (PMH), Variable reluctance stepper motor(VR), permeance model, Claw pole motor, Cogging torque, Core losses, Dynamic characteristic, Mid-frequency resonance, State- space model, Stability analysis