Development and Performance Analysis of a Magnetorheological Fluid Clutch

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Abstract

Automotive industry needs smart technologies to enhance their torque capacity or clutching actions. MR fluid is one of the material whose properties can solve the issue of improvement in torque capacity of automobiles. In this paper MR clutch is designed and developed. The theoretical torque transmission capacity of the MR clutch is found by using Bingham-Plastic constitutive model. Its performance analysis is done by simulation results. COMSOL Multiphysics® is used for simulation. Two-dimensional axi-symmetric geometry of MR clutch is used for magnetic field and computational fluid dynamics study to analyze the magnetic circuit and MR fluid flow. The magnetic fields interface of COMSOL Multiphysics® is used to compute magnetic field and induced magnetic flux distributions in the whole domain of the MR clutch.The physics interface solves Maxwell's equations formulated using the magnetic vector potential and optionally for coils, the scalar electric potential as the dependent variable on full field. For selecting the magnetic field, the full field is used. The simulation results shows the relation between torque developed in MR clutch with applied coil current. To find the velocity distribution and dynamic viscosity of MR fluid through simulation it is considered as incompressible and its flow as Laminar. In COMSOL Multiphysics® laminar flow study is a part of the fluid flow physics, used to simulate single phase flow of fluids. The laminar flow interface is used for simulating fluid flows at very low Reynolds numbers. The MR fluid behaves like single phase non Newtonian fluid.The equations solved by the incompressible laminar flow interface are the Stokes equations for conservation of momentum and the continuity equation for conservation of mass. Results obtained from the simulation shown graphically as in the form of surface plot and line graphs.

Figures used in the abstract

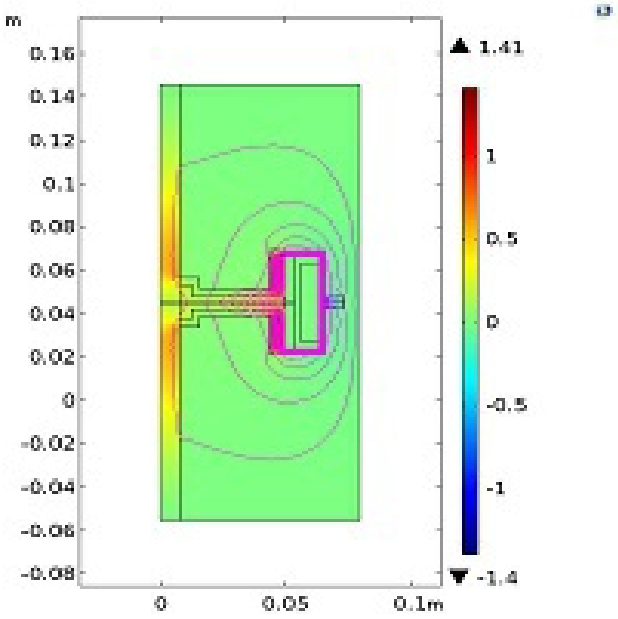

Figure 1: Figure 1. Magnetic flux density at 0.5A for MR clutch