50/100kW, 1350-7000rpm (600Nm peak torque, 40kg) PM assisted Reluctance synchronous machine: optimal design with FEM validation and vector control

L. Tutelea, Ana Moldovan (Popa), I. Boldea, Life Fellow, IEEE
University Politehnica of Timisoara, Romania

Abstract
The aim of this paper is to introduce – by general analytical nonlinear and then optimal design with vector control a hybrid electric and electric vehicles (HEV/EV) electric propulsion system for 50/100 kW, 1350–7000 rpm (600Nm peak torque/40 kg) at above 91% overall efficiency 300 Vdc battery for a peak phase current of 520 A. After searching quite a few alternative electric machines the low weight (40 kg) NdFeB (1.1 T) PM–Reluctance synchronous machine with vector control was developed in detail. Finite element validation of flux density, torque, inductances and non-reconfigurable vector control for the entire peak torque (power) very challenging envelope substantiate a moderate cost high performance HEV (EV) drive.

A high torque density, high efficiency PM-RSM drive of 50/100 kW for 1350 rpm – 7000 rpm, 300 Vdc for efficiencies above 92-93% for the optimally designed solution for a 520 A peak phase current and a 40 kg active materials weight (out of which only 2 kg of 1.1 T NdFeB magnets) are required.

References