Development and analysis of a High Speed Homopolar Machine

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This thesis presents the development and Analysis of A High speed Homopolar Machine (HSHM). The HSHM was investigated in the rated power range of up about 100 Kw and rated speeds of to rpm assuming a generator application of the HSHM in a hybrid car. A simplified two- dimensional dimensioning methodology was developed for handling the design work of a HSHM which is otherwise a three-dimensional task. In this work, the HSHM typical characteristically dependency of the power-density to the rated speed has been established and the feasible range is between rated speeds of 20,000 rpm and 50,000 rpm speeds. The HSHM has been found to behave as a near pefect non-salient reluctance machine despite its salient rotor poles. This prompted for an emphatic suggested definition of the q-axis in salient pole machines. A suggested axially slanting air gap in order to improve the distribution of the excitation-flux in the HSHM's magnetic circuit has been implemented. The experiments on the manufactured prototype showed a good agreement between the calculated and the measured parameters of the machine. Experimental investigation of the effects of making the prototype's rotor showed an improvement in the HSHM's aerodynamics resulting in improved efficiency. Keywords: High Speed, High Speed Electrical Machine (HSEM), High Speed Homopolar Machine (HSHM) , HSHM Laboratory prototype.