*PhD THESIS SUMMARY*

# CONTRIBUTION TO THE DEVELOPMENT AND OPTIMIZATION OF HIGH SPEED ELECTRICAL MACHINES FOR SPECIAL APPLICATIONS

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The PhD thesis present aspects regarding the development of the brushless high speed electrical machines.

The primary objective of the paper is to establish a new methodology for a DC brushless motor, from high speed electrical machines category, liable for higher performance compare with other solutions.

In *1st chapter* is made a introduction in the high speed electrical machines field and are presented a series of special applications for this type of machines. The chapter begins with a study regarding the current state, nationally and internationally, in the high speed electrical machines field, used in special and industrial applications. Are analyzed and described particularities, design issues and mechanical, thermal, electromagnetic or power control electronics limits encountered during development of this type of machines. Finally, are presented the main types of high speed electrical machines.

In *2nd chapter*, using special softwares for numerical modeling, is made a electromagnetic analysis for a machine with fractional number of slots per pole. The study begins with a very known solution for the special electrical machines designers, solution with 9 slots and 6 poles, and reach to a unconventional solution more efficient in comparison with the reference solution. Are presented both advantages and disadvantages of the new solution, but also of intermediate solutions.

Because in the design of the high speed electrical machines ar taken into account the electromagnetic problems and also rotor dynamics problems and the integrity of the materials that compose it, in the end of this chapter was done a computation of the self vibrations frequencies and a computation for centrifugal dynamic stress, on specific working speeds but at higher speeds to, for the solution proposed.

In *3rd chapter* are presented the control strategies and also drive motion methods for high speed electrical machines. In the end is presented the motion drive system design to control and command the DC brushless high speed electrical machine studied in this thesis.

The *4th chapter* it is intended to present the measuring methods for the functional parameters of the high speed electrical machines. Are described measuring methods for electromagnetic torque, breakaway torque, speed, temperature and moment of inertia. Also are presented complex modern equipments for high speed electrical machine testing.

In *5th chapter*, it is presented the motor-generator system preliminary design to be produced as experimental model, composed of: brushless high speed electric motor, a synchronous generator and a Hall sensors system. It was chosen this kind of system for testing the motor in load, to eliminate any loss due to a intermediate coupling, especially to eliminate the additional vibrations, occur at high speed.

The experimental measurements of electrical and thermal parameters for the experimental model was made in Sistem Euroteh Romania laboratory, and experimental measurements of vibration, in Colibri Spindle LTD Israel laboratory, to validate the numerical models used for this type of high speed electrical machines.

The *6th chapter* ends the paper with the presentation of the final conclusions on the topic addressed, personal contributions and future research direction synthesis.