

Final Report Summary

Feasibility Study on position sensed and sensorless control algorithms for brushless DC motors



Lothian Electric Machines Ltd (LEMAC)
www.lemac.com

Heriot Watt University
www.hw.ac.uk

Introduction

Lothian Electric Machines Ltd (LEMAC) has designed and manufactured electric motors and generators in Scotland for 50 years. They have the skills and experience to develop electrical machine designs and optimise their performance to best meet customers' requirements. LEMAC wish to diversify their product range to include brushless DC motors and an associated sensorless power electronic drive. The motors and drive combination could then be used in light electric vehicles (EVs), for example, golf carts, power wheelchairs, and stair lifts. However, third party power electronic drives are currently used which are not optimised for the particular applications in which our motors are used. Excellent market potential has been identified in integrated drives using brushless DC motors and LEMAC has a need to develop drive control units. The project will investigate the feasibility of implementing position sensed and sensorless control algorithms on low cost motor control ICs with a view to developing our brushless DC product range and associated drives.

Description of Work

The work undertaken on this project involved the design and test of a prototype low-cost permanent-magnet motor and an associated controller. The main aims were

- to evaluate suitable single-chip motor drive solutions for the prototype machine
- to investigate the effectiveness of sensorless control techniques with the prototype
- to determine the performance of the machine
- to refine the prototype design.

Extensive experimental work was carried out during this project and significant advances in the design of the prototype machine and associated controller have been identified through this work. A test rig including prototype brushless machine and load generator was constructed and tested with an off-the-shelf motor control unit. A number of back-EMF sensing techniques were evaluated for sensorless control, and compared with control using a position sensed system. The experimental and simulation work has provided LEMAC access to a considerable amount of expertise in machine design and testing, power electronic development, and system control.

Conclusion

This work has benefited LEMAC in a number of ways. Firstly, the award has facilitated access to a leading academic knowledge base on motor drives and control. This has provided a significant number of design improvements to the prototype brushless DC machine. Secondly, it has assisted in building a lasting relationship between the two parties. Thirdly, it has moved the product significantly closer to market and provided confidence in the technological capabilities of the company. The project has helped to identify a number of design improvements and new opportunities to develop the product, and potential routes for further academic collaborations and support mechanisms.

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