USE OF A STANDARD SIX-PACK POWER ELECTRONIC CONVERTER FOR SWITCHED RELUCTANCE MACHINES

Introduction

Switched reluctance machines are a type of electrical machine. They typically benefit from a lower intrinsic cost due to their relatively simple construction and because the use of permanent magnets is avoided. Unfortunately, with today's state-of-the-art the potential cost savings are nullified by a higher cost of the power electronics. The main reason is that until now Switched Reluctance Machines are standard controlled and driven with Asymmetric H-bridges and there was no technology available to control and drive such a machine with standard power-electronics (a so-called standard six-pack).

TECHNOLOGY OFFER

Our invention allows to use a standard low-cost power electronics six-pack solution (conventional three-phase-bridge) to control a traditional Switched Reluctance Machine. This is done by putting the phases of the machine in a ring structure and to inject a DC type of current into this ring. The six-pack then injects superposed to the DC current an AC current. Doing so, the obtained current waveforms can be similar to the current waveforms normally used. There are many (smart) and low cost ways to realize the DC current.

Applications

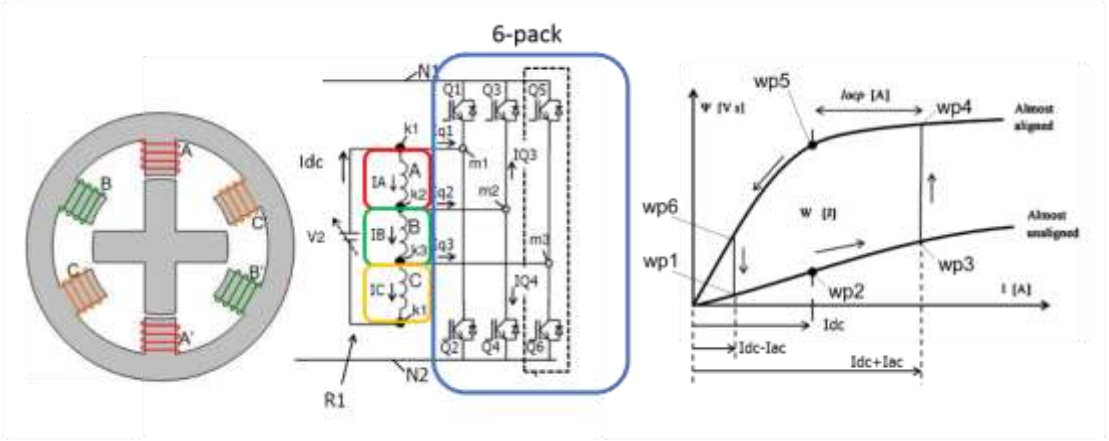
Applications are electrical motors for vehicles and machines, generators in wind and wave energy harvesting, stand-alone generators, generators for combined heat power, range extenders for electric vehicles, general purpose generators … The invention covers both three phase as well as multi-phase systems.

Advantages

The key advantages are the ability to use a standard six-pack without changing the electrical machine. A further benefit is that the rating of the active semiconductor in the six-pack is merely halved. Compared to the traditional power electronics our invention allows to cut down the costs for the power electronics almost by 50%. Our market analysis shows that this is an interesting solution for medium volume applications (for high volume probably a dedicate half-bridge module would be developed).

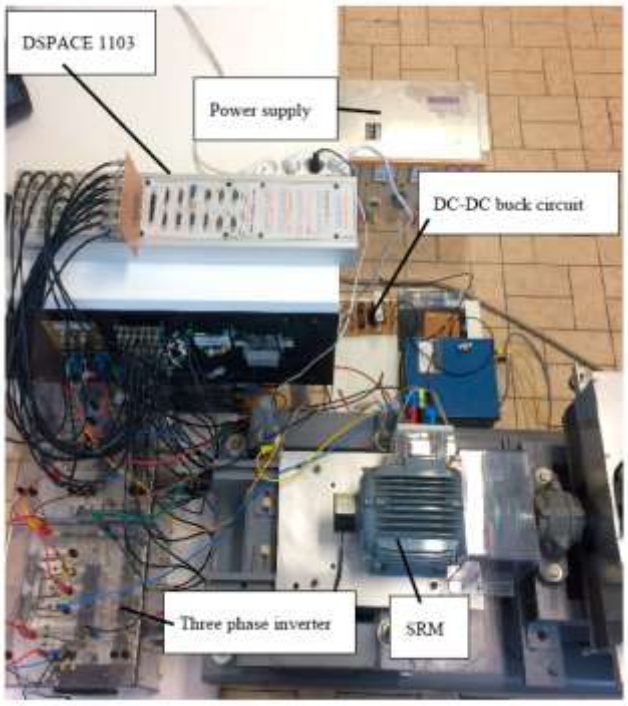
Figure

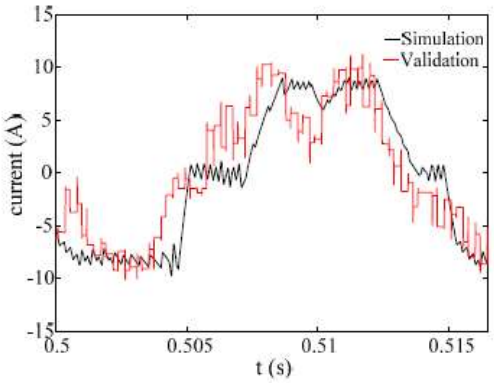
The figure below shows the three phase windings (A, B and C) of the machine, the power switches Q1-Q6 are the standard 6-pack comprising three legs. V2 is a dedicated low cost source injecting a DC current Idc. The figure below shows the interconnection of the power electronics with the machine as well as the Flux-current diagram.

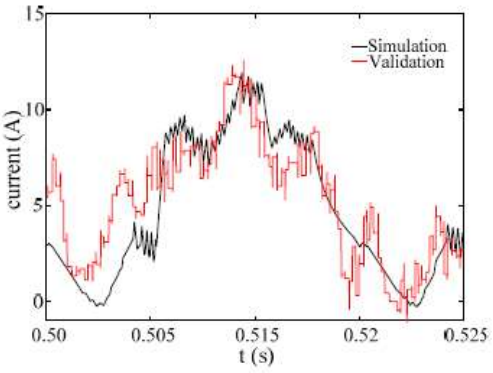


State of development

We have a working prototype running in our laboratory which proves it is possible to drive an off-the-shelf SRM with a standard full bridge inverter and an additional DC source. The prototype setup consists of a representable SRM motor coupled to a breaking machine with torque sensors, a conventional inverter box, current sensors, position sensors, a 200 V DC power supply, a DC-DC buck circuit, a DSPACE 1103 controller board and a PC with DSPACE 1103 blocks. This setup demonstrates the use of the technology for an SRM motor in several working conditions (start, stop, acceleration, deceleration) under different load scenarios. Measurements are available for example of currents in the motor windings and power electronics. We are currently working on fine-tuning of the controls and on quantitative validation of simulated currents. The following diagrams show simulated versus measured currents in the inverter and winding at a speed of 1000 rpm and a load of 8 Nm.







Partnership

The patent is offered to companies which have the possibility to obtain a license on the patent or to have it transferred.

Intellectual property

SWITCHED RELUCTANCE MACHINE AND POWER CONVERTER
WO2017191298, international filing date: 04/05/2017, filed for protection in EU and US.
The international search report shows a considerable amount of claims that are novel and inventive.

The Scientist(s)

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Keywords

Switched Reluctance Electrical Machine (SRM), Power electronics (PE), H-bridge, Six-pack power electronics

References

https://www.mdpi.com/1996-1073/11/12/3242

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