Venus Project | Newsletter

July 2015

MAIN ACHIEVEMENTS OF VENUS TEAM

It is a pleasure for the Venus team to introduce you the first newsletter of VENUS project. VENUS started on November of 2013 and during these months significant advances have been achieved. We would like to show to the audience these achievements. Please let us first to introduce the project to follow with the main milestones already fulfilled and the next steps of the project.

What is Venus Project?

For a large scale introduction of Electric Vehicles (EV) in Europe, adequate volume supply of current Permanent Magnet (PM) based motors could be at risk, as the rare earth metals can only be found under single source monopolies. In this context, the development of high efficiency motors using a limited amount of permanent magnets or completely new magnet-free motor designs is crucial.

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VENUS project objective is to design a new concept of electrical drive including motor, control and inverter to replace the PM based motors. The main targeted results of the projects are.

- Replacing or greatly reducing rare earths content, or innovative magnet-free designs.
- Increased efficiency, including Smart packaging of power electronics and integrated thermal management
- Optimized design and processes for manufacturing and dismantling

The design will be tested in a real application integrating the developed drive in a real Electric van and testing the performance of complete system.

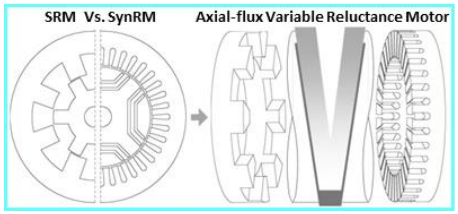
The electric motor

It should be noted that magnet-free electric machines have been around for a long time and have been used in all kinds of applications. Among the different magnet-free technologies, induction motors are the most mature due to their robustness and reliability. However, despite their maturity, they do not present significant better performance (efficiency and power density as far as EV applications go) in comparison with other less mature technologies.

Variable-reluctance technology is a promising alternative technology for EV applications in order to meet the required efficiency and power density levels, in which 3 alternatives can be found:

- Switched reluctance (SR) machines.
- Permanent-magnet assisted synchronous reluctance machines (PMSynRM).

However these topologies exhibit inherently lower power density than PM motors at same size. To compensate this disadvantage, Axial flux topology is employed. Combining Axial flux topology with variable reluctance motors, a competitive electric motor will be designed with high efficiency and a compact design.



VENUS bets for an axial-flux variable-reluctance machine, SRM or PMSynRM

VENUS team

- ***IK4-TEKNIKER. (Spain)***

Is a private non-profit Research Centre. Is an active research organization that brings into VENUS critical expertise related to precision engineering and mechatronics, especially on the design and manufacturing of electric machines.

- ***FAGOR ELECTRONICA S. COOP (Spain)***

Fagor Electronica designs, produces and sells electronic products for the automotive market for more than 18 years and has been audited and approved by a large majority of OEM car. The current catalogue includes inverters for electric machines from 4 A to 200 A and 130 kW.

- ***Lotus Engineering (United Kingdom)***

Lotus Engineering is one of the world's most exciting and dynamic automotive engineering consultancy and advanced technology companies.

- ***DR.-ING. ERNST BRAUN GMBH (Germany)***

Dr.-Ing. Ernst Braun GmbH is an R & D office for electrical motors. The field of activity comprises the consultancy concerning manufacturing and the delivery of prototypes and even of components.

- ***Motor Design LTD (United Kingdom)***

Motor Design Ltd. (MDL) has been developing electric motor simulation software since 1999 and is now a world leader in the development of advanced software design tools for thermal analysis of electrical machines.

- ***MONDRAGON UNIVERSITY. (Spain)***

Mondragon Goi Eskola Politeknikoa S.Coop is the Faculty of Engineering of MONDRAGON UNIBERSITY (MU). MONDRAGON UNIVERSITY brings into VENUS critical expertise related to the design and control of electrical machines and the integration of electrical components in vehicles.

Project realization

Venus Team worked towards the following tasks

- Specification of the drive to design
- Selection of the most suitable motor topology
- Design of selected topology motor
- Start with the fabrication of the motor

Specification Meeting:

Lotus Engineering April, 2014 UK

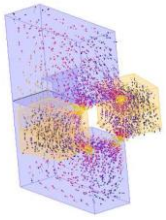
In April of 2014 the first technical meeting of VENUS team was celebrated in Lotus facilities.

In this meeting the performance of the new concept of motor was discussed. Once that the specifications were fixed electromagnetic and thermal design started for both topologies, SRM and PMSynRM.

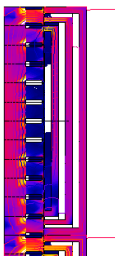
Topology selection:

Fagor elect S. COOP November, 2014 Spain

In this meeting, the selected two topologies were compared in terms of efficiency, power density and manufacturability. For both option some simple finite element simulation were done to obtain a basic sizing of machines.



SRM



PMSynRM

Both machine exhibit similar performance. The efficiency, power density and thermal behavior of both topologies were similar. However we considered that the manufacturability of SRM is more feasible to large scale production so finally SRM topology was selected for the detailed design of the VENUS project machine.

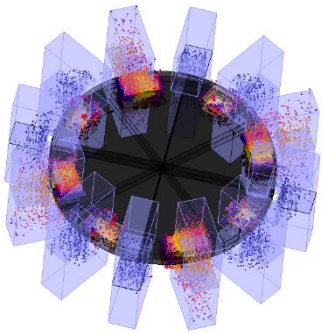
Design Meeting

Mondragon University May 2015 Spain

Once the topology was selected, all the aspect of the new drive have been designed in detail.

SRM topology has been selected for the detailed design of the VENUS project machine

The electromagnetic design has combined analytical tools with FEM simulations. Thermal aspect has been also taken into account in the performance evaluation of the design.



Apart from the electrical machine issue, control and power electronic aspects also have been considered in the design process.

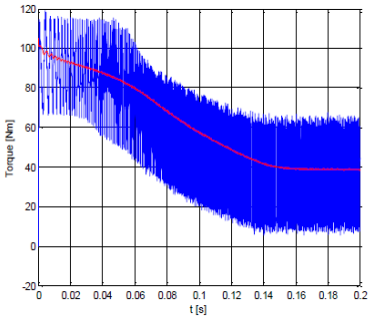
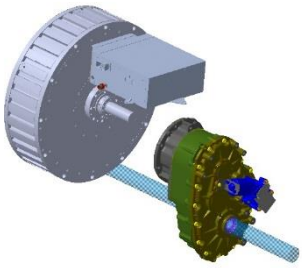


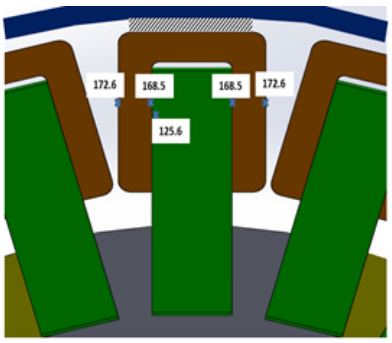
Figure 77: Torque waveforms at acceleration response

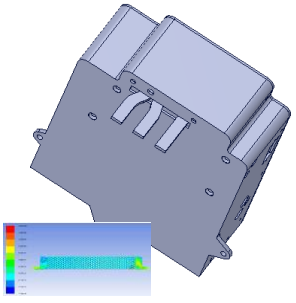
The design has taken into account the available space of the Van where the drive will be integrated in the final experimental demonstrator.



With all the elements of the drive designed, the fabrication has started on July. In the following months first parts of the VENUS new drive concept will arrive.

The Fabrication of different parts has been started





Upcoming step

The next meeting of VENUS team will be hosted by *DR.-ING. ERNST BRAUN GMBH* in Germany in November. We will discuss about the ongoing of the prototype and the tests that we will be doing.

This year we will the evaluation of performance of VENUS motor tested on Test Bench.

Contact Us

FOR MORE INFORMATION
For more information please visit the VENUS project website: http://www.venusmotorproject.eu
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