From Solar Racing to Ultra Commuter

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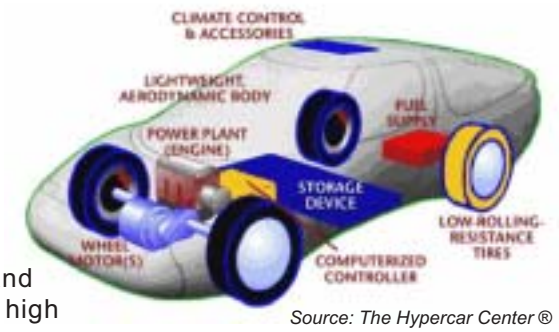

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Vector Fields recently supported the activities of the Sustainable Energy Research Group (SERG) of The University of Queensland, located in Brisbane Australia. This group is in the process of developing an UltraCommuter, a highly efficient, yet practical, sustainable passenger vehicle. The key features of the vehicle are as follows;

- Ultra-lightweight construction using advanced composite materials
- Low drag design to drastically reduce aerodynamic and rolling resistance
- Advanced hybrid-electric drivetrain
- Integrated electronics and digital control system
- Energy-efficient accessories
- No compromises in vehicle performance, utility and comfort!

The group stems from a background in Solar Car racing where they have been racing competitively for over 5 years. The core team members of the University of Queensland Solar Racing Team have recently moved into postgraduate research studies to develop this new concept vehicle. The UltraCommuter project will be conducted for approximately two years, with a target completion date of October 2003 for the World Solar Challenge.

One of the goals of this project is to develop two light-weight direct drive wheel motors and a high efficiency generator for the hybrid unit. The team has successfully utilised a Permanent Magnet (PM) ironless core wheel motor for their Solar Car and they are now utilising Vector Fields OPERA-3d to further develop this type of machine for use in the UltraCommuter. The first stage of motor development has commenced with the design and construction of a high speed, high frequency ironless generator. Figure 1 shows a cross-section of a motor topology that is currently under construction at The University of Queensland. Note that the magnets are only placed on the inner diameter of the outer backing iron such that they will be able to withstand high-speed operation.

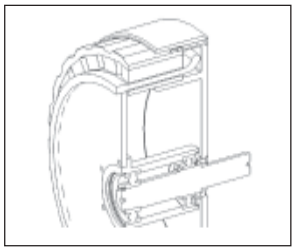

Figure 1: cross section of a motor topology

The absence of a steel core results in no iron core hysteresis losses and with the use of fine stranded Litz wires the copper eddy current losses can also be minimised. These factors mean that PM ironless machines can be designed for high frequency operation, with high efficiency and over a wide power and speed range at a low overall mass. Figure 3 shows the last magnet being bonded into position on the rotor.

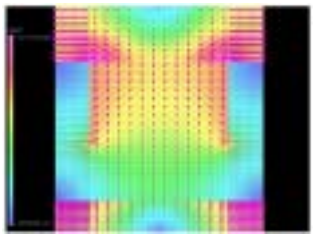

Figure 2 magnetic flux density for a single pole

Figure 3: The final magnet being bonded in position

To provide good performance the UltraCommuter will require each of the rear wheels to be fitted with motors capable of producing torques of up to 500Nm for short periods. In general the mass of a motor is approximately proportional to the torque that it must produce. For a wheel drive the mass of the motor and transmission is particularly important, due to unsprung weight considerations. The team is once again looking towards PM ironless motors to provide a solution. In order to reach the torque densities required the wheel motors will be fitted with liquid cooling. Electromagnetic Finite Element Analysis will be heavily drawn upon to reach the extremely high specific torque required (in excess of 25 Nm/kg) and to keep the use of magnetic material to a minium.

VF Consulting Powers Ahead

Vector Fields has always had a strong presence in providing consulting services in electromagnetic modelling and design. The reasons that customers require these services vary, with the most common ones being:

- one - off problems for which investment in in-house skills is not economic,
- difficult problems that go beyond existing OPERA and CONCERTO users' experience,
- peak demand on experienced software users at the customers' site.

Increasingly in recent years however, some companies are relying on outsourcing some of their design skills – and electromagnetic design is no different. The trend has been seen throughout the world and both VF Inc and VF Ltd have seen their consulting income nearly double in 12 months. Many of VF's agents and distributors also provide similar services, as well as the extensive network of VF Consultants that operate in Europe and North America.

The range of projects tackled in recent months reflects the wide applications experience within the Company. Some of the most important are:

- electromagnetic interference from railway systems,
- induction heating processes for the chemical and metals industries,
- miniature cathode ray tube for aircraft visualisation equipment,
- flat screen displays,
- electrostatic precipitation on an oil production platform,
- medical imaging magnets,
- turbine generators,
- accelerator magnets,
- X-ray tubes.