# Prospective Space at Elec 2000 - Technicrea: Wheel Motor for Electric Scooter.

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## ❖ Introduction

For several years Technicrea Recherche has developed, among others things, electric motors of wheel type in collaboration with the Franche - Comté University. The essential properties of this technology provide interesting characteristics in terms of vehicle traction (compact device, high values of specific power and torque, high efficiency …. ) making it possible to eliminate the reduction gear.
The built prototypes range from the bike pedal-assisted motors (250 W, 30 Nm), to scooter motors, motors for city small vehicles (3 - 5 kW) on batteries or fuel cell (for example the European project VELAPAC, presented by CNIM on the Prospective Space at ELEC 2000) and end with high-power motors (30 kW, 6000 Nm), for military armoured vehicles or for buses.

## ❖ Characteristics and performances

- The scooter electric wheel motor is a auto-piloted three-phase synchronous type, with permanent magnets and reversed structure (rotor outside, as a part of the hoop).
- Hall sensors are placed in the stator, in order to supply information on the rotor position to the PWM voltage converter.
- Rated power: 1350 W, maximal power: 3000 W.
- Battery voltage: 36 V.
- Rated speed: 500 rpm.
- Integration in a 12" hoop, without reduction gear (direct motor action on the hoop).
- Efficiency: > 80 %, between 300 rpm and 500 rpm.
- Dimensions: outer diameter 260 mm, global thickness < 100 mm.
- Total weight: about 12 KGs.

## ❖ Tools for electromagnetic design

To obtain such interesting performances we use a software for the electromagnetic computations, for optimal conception with constraints, developed by our university partner. This software is based on an analytic model of the machine, associated with a gradient algorithm. This model partially takes into consideration the magnetic saturation. An optimisation of the analytic dimensioning is achieved with the finite element software FLUX2D. This optimisation allows the assurance of in-torque performances, induced voltage, the level of machine saturation and the magnet demagnetisation. The following two figures show the value of the magnetic flux density and the magnetic field lines for a synchronous machine with permanent magnets and reversed structure.

## ❖ Perspectives

This motor yields very good dynamic performances and provides the vehicle with optimum road behaviour. At the moment, the aim is to industrialise the product in order to obtain costs for series production compatible with the automotive industry.
Our technology can be easily adapted to different types of vehicles (road, industrial, …). It can be also used for other applications, such as motorised elevators, planes, buses, ships, ...

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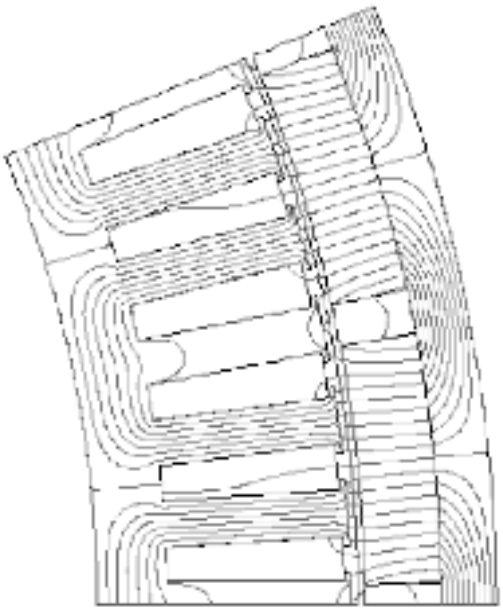

*Figure 2 - Magnetic field lines of an wheel motor (FLUX2D modelisation).*

*Wheel motor for electric scooter.*

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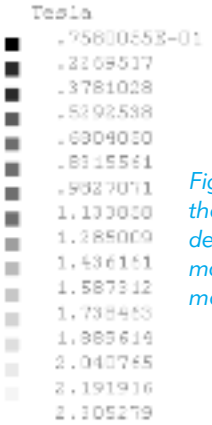


*Figure 1 - Chart of the magnetic flux density for an wheel motor (FLUX2D modelisation).*