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Optimization of an Axial-Flux Permanent-Magnet Generator for a Small Wind Energy Application

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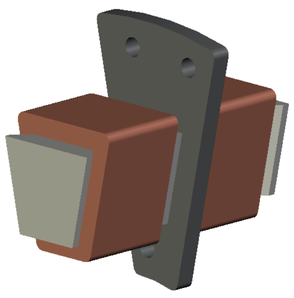
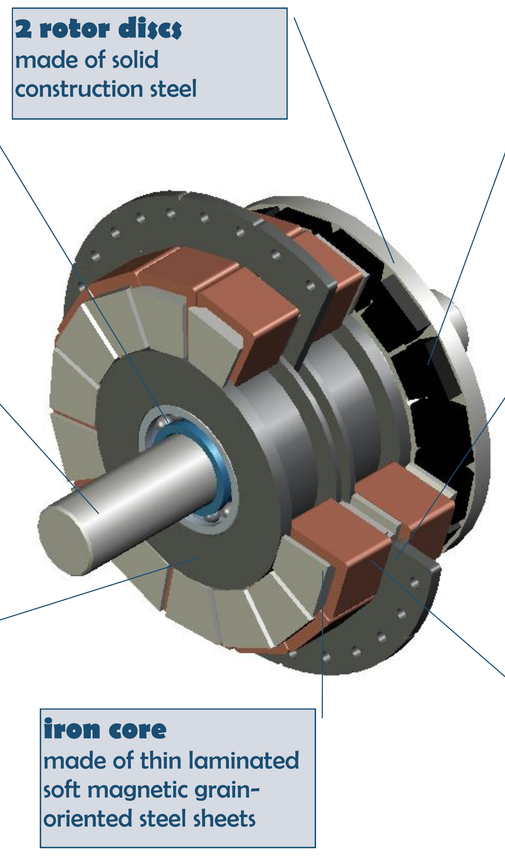
Axial-Flux Permanent-Magnet Generator
- each iron core is made individually using thin laminated soft magnetic grain-oriented steel sheets: high permeability and low losses
- concentrated double layer winding is wound around the iron core;
- an individual mechanical fixation is made to prevent axial and radial movements;
- the pre-assembled modules are combined into the stator housing
- reduction of cost and manufacturing complexity





Axial-flux permanent-magnet synchronous machines have a high torque output at low speeds and are therefore very suitable for direct drive wind energy applications. This research focuses on: measures to improve the efficiency of the energy conversion; simplification of the construction and easy maintenance by introduction of a modular stator construction; adaptations required to obtain an efficient power conversion in direct drive wind energy applications.

http://www.eesa.ugent.be

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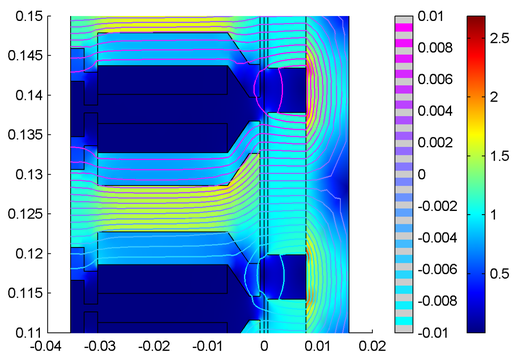
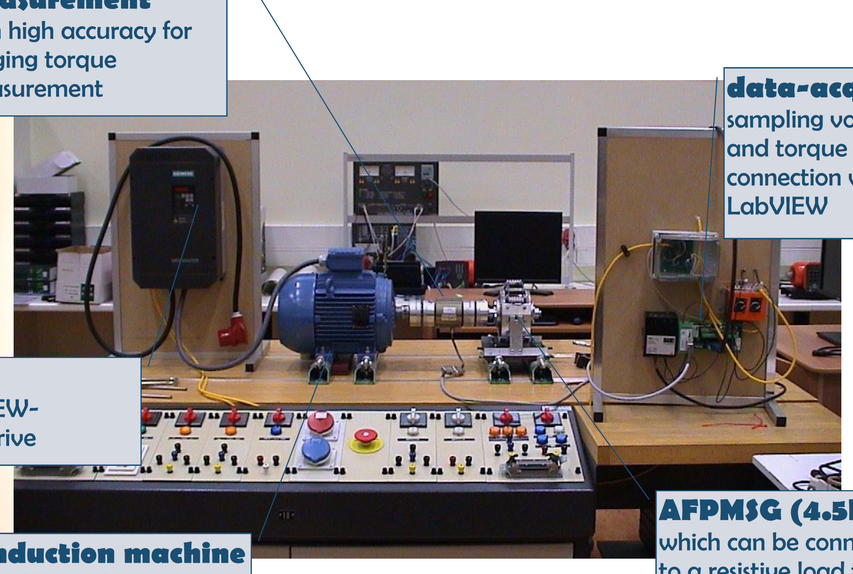
Simulations are done using finite element computation, and an experimental setup is built to verify the simulation results using a prototype machine.





Some adaptations to the axial-flux permanent-magnet synchronous machine topology are necessary to allow efficient power conversion for a direct drive wind energy application:
- shaft speeds are low: large pole-pair number to obtain a sufficiently high frequency;
- optimization based on the probability density function of the wind speed:
  - most of the time, the generator will work at partial load;
  - annual energy output instead of efficiency at full-load.
- cogging torque reduction for smooth start-up;
- resistance to brief periods of overload during gusts.

In this BOF-associatieonderzoeksproject, both Ghent University and University College Ghent are involved.

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