Lehrstuhl Steuerung, Regelung und Systemdynamik

Master/Bachelor Theses

Construction, Experimental, Simulation

Small vertical axis wind turbines operation using flywheels

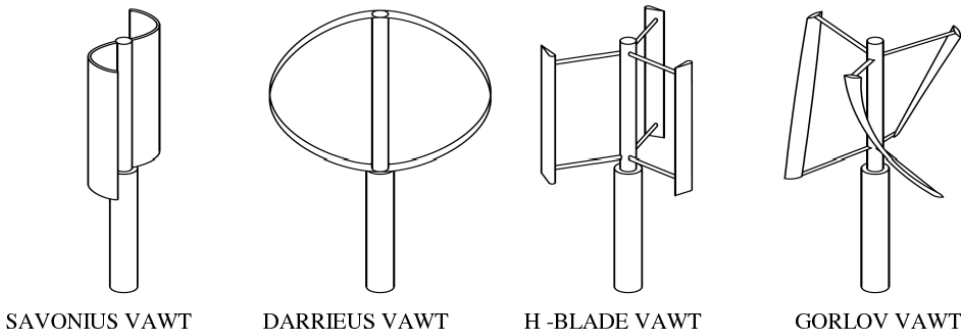

Figure 1: VAWT categories [Casini, 2016]

Conditions

Duration: 3-6 months
Rquirements: MATLAB/dSPACE/
3D printing/Simulation/CFD
Language: English
Target group: Master/Bachelor students

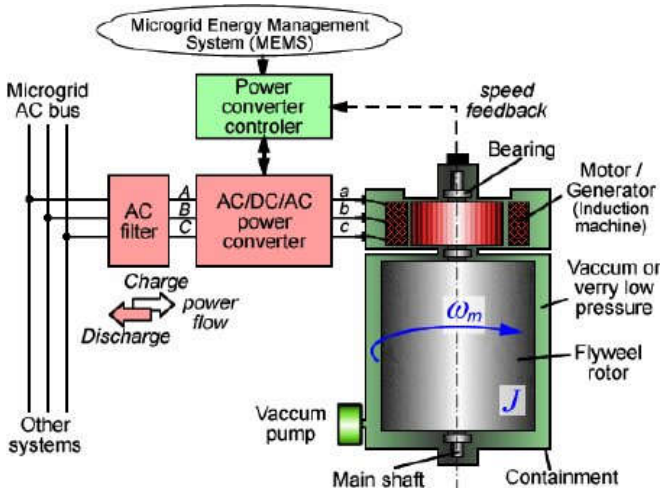

Figure 2: Flywheel energy store system [Tameghe et al., 2015]

Content

Distributed/social energy is a developing area allowing individual people to participate in clean energy production. Small wind turbines are one of the most potential distributed energy resources. Vertical axis wind turbines (VAWTs) offer a number of advantages over traditional horizontal axis wind turbines (HAWTs) in small-scaled urban applications. VAWTs work better than HAWTs in low speed and high turbulent wind which is the typical case of the household condition. In addition, VAWTs do not need a complex mechanism to track the wind direction make it is easier to operate and maintain.

In these theses, a flywheel energy storage system (FESS) is used in combination with VAWTs to reduce and to optimize the power output fluctuations due to varying wind speed. The system to be designed contains a small-scaled VAWT (200-500 W) and also related FESSs and has to developed and constructed. Measurement and control systems based on dSPACE are to be designed and to be implemented. Experiments are required using the constructed system with varying wind profiles.

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The main tasks of the work are summarized as follows:

Bachelor thesis: Development of a variable wind source for VAWT experiments.

- Design and manufacturing of a variable wind source for a 200-500 W wind turbine
- The wind source is measured and controlled by a dSPACE system
- Adjustable wind profile is required
- Documentation and presentation of results

Master thesis 1 (Modeling): Modeling and evaluation of VAWT-FESS combined systems.

- Review of VAWTs and FESSs
- Modelling of VAWT-FESS combined systems
- Comparison of different configurations is required
- Documentation and presentation of results

Master thesis 2 (Mechanical): Design and development of a VAWT-FESS combined system using smart design based on 3D-printed components.

- Design and manufacturing of a 200-500 W VAWT
- Design and manufacturing of a 200-500 W FESS
- Experiment and efficiency evaluation with varying wind profile
- Documentation and presentation of results

Master thesis 3 (Electrical): Development of measurement and control for VAWT-FESS combined system.

- The measurement and control system is developed using a dSPACE system
- Design and choosing of sensors
- Design and manufacturing drivers for VAWT and FESS
- Control the energy flow between VAWT and FESS
- Experiment and efficiency evaluation with varying wind profile
- Documentation and presentation of results

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