Development of a 2HP Solar Water Pump Inverter using VisSim and TI InstaSPIN sensorless control

Degree programme: Master of Science in Engineering | Specialisation: Energy and Environment
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External project partner: ennos ag, Nidau

The sunlight pump, a product of ennos ag, is a portable solar pump for smallholder irrigation and domestic water supply in developing countries. It has the benefit of reducing harmful environmental emissions by working with a renewable energy source. Both the motor and the electronic control system are being constantly developed further at the Bern University of Applied Sciences under the supervision of Prof. Dr. Andrea Vezzini.

A solar pump of 0.5HP has already been launched into the market. Since there is the need for a powerful system for certain agricultural applications, such as to provide a higher head and a greater quantity of water, a 2HP power pump is under development. In the current version, the rotor position is detected through Hall-sensors for controlling the motor. However, a new motor control system can be implemented to detect the rotor position without using sensors but measuring the phase currents and voltages.

Implementation

Within the scope of the development roadmap of ennos ag, a three-phase inverter prototype for the 2HP pump has been developed. In order to reduce the system costs and increase reliability, the Hall-sensors for measuring the rotor position have been dispensed. Thus, the permanent magnet synchronous motor is controlled without sensors by means of field-oriented control and an observer. The heart of the inverter is a Piccolo microprocessor from Texas Instruments. The InstaSPIN-FOC software solution enables the sensor-free identification, optimization and control of all types of three-phase, synchronous or asynchronous motors. The software is developed on a visual environment model based system, called VisSim/solidThinking Embed. Furthermore, the new inverter offers a Bluetooth and a GSM interface to allow software updates, fast data communication and operation statistics.

Perspective

Tests of the complete soft- and hardware are planned with a pump able to deliver up to 300 liters of water per minute. Once the tests are concluded, a new PCB will be designed with possible improvements. On the software side, a controller for the MPPT and tasks for the communication interfaces will be implemented.

Outlook

Based on this work, the inverters for the future ennos' pump generation will be implemented with greater ease. We have seen that use of sensorless control removes the need for a mechanical motor rotor sensor and influences the final system cost, therefore we find InstaSPIN to be promising.

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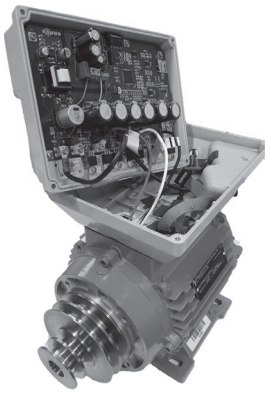
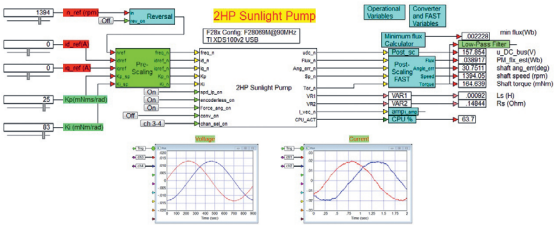


2HP Motor and Inverter



Real-time debugging by solidThinking Embed