

Developments for a further efficiency increase of the Sunlight Pump

Subject: Industrial Technologies

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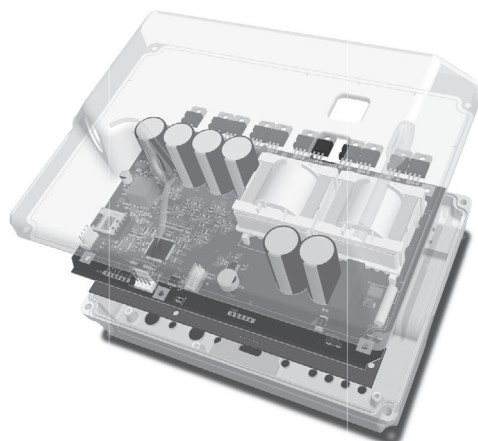
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The “Sunlight pump”, a product of ennos GmbH, is produced and manufactured in Bangalore, India. The benefits of this system is the independence from non-renewable energy sources. This leads to a substantial decrease in investment costs, especially for farmers in developing countries. The core components of the Sunlight pump system are the brush-less DC motor and the electronic control system. Both components are constantly developed at Bern University of Applied Sciences.

The main goal of this thesis was to increase the overall solar driven water pump system efficiency by developing alternative ways to control the system and by improving the system's hardware design. The production of a 9 A Sunlight pump has already started in Bangalore. However, because of the non-linearity and the interaction of the different controllers running in parallel, the stabilization in multiple operating points is difficult.

Improvements

A new control algorithm has been implemented in order to increase the solar water pump efficiency by allowing an entirely variable DC link voltage and at the same time by simplifying the control structure. This led to an optimized motor commutation method. A new inductor design in a 2 way interleaved booster topology and a new power supply structure are the main improvements on the hardware. Matlab, Simulink and PLECS were used to develop the new algorithm and controller design. The effects of parameter uncertainty and discretization can be analyzed in a virtual environment. Various simulations show that the system's efficiency can be increased by 10% especially at low angular speeds and high load torque.



Re-designed PCB with Housing

Experimental Setup

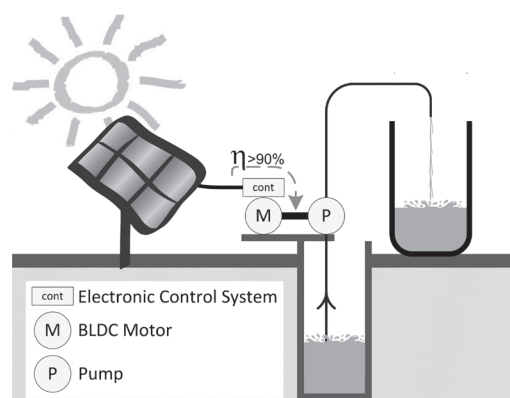
A fully automated, custom-made motor and pump test-bench were developed and constructed, in order to evaluate the effect of the implemented hardware and software changes on the overall performance of the system.

For the analysis, a motor and electronic control system efficiency map with 100 measuring points can be created within 25 minutes for operating points up to 5 Nm and 2000 rpm.

A controlled water circulation system between a pressure and a vacuum tank is the heart of the pump test-bench. Like this, the whole running Sunlight pump system can be measured for different pumping and suction lifts. The motor and the pump test benches allow an easy characterization of the effects of the new developed soft- and hardware.

Breakthrough

Several results presented in this thesis have already had a direct influence on the soft- and hardware, as well as on the manufacturing and production processes of the Sunlight pump in Bangalore. Various approaches of the control algorithms could be implemented on the actual hardware and the same pump test bench system was built up at the production facility in Bangalore. Henceforth, each pump will be tested on this similar pump test-bench before delivery.



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