Contribution ID: **306** Type: **Poster Presentation**

Optimized Small Scale Hydropower Generator Electrical System Design & Modeling Based on Real-Measurements

Thursday 7 July 2016 14:40 (20 minutes)

This paper proposes design and implementation of a small scale micro-hydro power electrical system capable of supplying a house near flowing water with sustainable power. A small scale hydropower turbine system and a larger system using a DC power supply generator are built. Real small hydro-generator associated with electric generator is used with a simple load, rectifier, and dc-dc converter. Larger system will use programmable power supply attached with rectifier to act as the larger hydro-turbine system is used. DC to DC converter is used to regulate the voltage level. Instead of using a battery to store energy, a Supercapacitor and static capacitors are used to store the energy. Smart dc load equipment is used to act as the compatible dc loads for smart homes. Full-wave bridge rectifier, and inverter after the storage devices are designed and implemented. A caparison between the two different types of capacitors static and Supercapacitor one is introduced. Artificial Neural Network (ANN) is used with feed forward back-propagation technique to implement Charging and discharging ANN models for load range up to 150 W with Time and Voltage as inputs and Energy and Current (Watt) as outputs. These models are checked and verified by comparing actual and predicted ANN values, with good error value and excellent regression factor to imply accuracy. Finally, the algebraic equations and Simulink models are generated and deduced to use them without training the neural units each time. Optimized genetic process for the discharging models of both types of capacitors is adopted. A genetic algorithm is formulated to maximize the energy with respect to the time and load range. Energy is the objective function with bounds for voltage as optimizing variable. All results are simulated with MATLAB, and Genetic Optimization Toolbox. A noticeable improvement is appeared in performance parameters.

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Session Classification: Poster 2-A

Track Classification: Power Electronics, Power Supplies, Prime Power, Rotating Machines, and Energy Converters