UNIVERSITY OF FLORIDA

Non-Contact Energy Delivery for PV System and Wireless Charging Applications

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Description: Innovative non-contact energy delivery method will be used in photovoltaic energy generation system to accelerate the system deployment. Instead of delivering electric power using cables penetrating through building structures, magnetic field coupling allows power to be transferred wirelessly through building walls and roofs. In the meantime, the DC electric energy from photovoltaic cells is converted to AC energy. This enables the photovoltaic system to be quickly set up or relocated, and the collected solar energy from outdoor system can be conveniently delivered to indoor appliances. Techniques to achieve high efficiency at high power delivery through different building structures will be studied for this plug-and-play architecture.

In addition, the technique and the system can also be used for non-contact charging of electric vehicles. The transmitter/charger can be placed as a mat on garage floor or parking space. The receiver inside vehicle will pick up the energy delivery through magnetic coupling. This eliminates the need of connecting charging wires to vehicles and exposed metal contacts, which is a safer method of charging electric vehicles.

Budget: $252,000

Universities: UF

External Collaborators: NA

Progress Summary

In the previous report, we described the design and experimental results of extending the magnetic induction electric energy delivery system from a close distance of 1 cm to 50 cm. The results demonstrated that 50% efficiency can be achieved when the two coils are separated by 50 cm. In this report, the distance is further extended to 1 m, and the peak efficiency reaches 58%.

I. Design of the System

Fig. 1 shows the block diagram of the system and a picture of test setup. The DC-AC inverter provides the AC power to be transmitted to the receiver. The inverter is a class E switch-mode power amplifier. Following the inverter is an impedance transformation network, the purpose of which is to maximize power transfer and efficiency by transforming the impedance looking into the transmitting coil. The transmitting coil follows, which is in turn inductively coupled to the receiving coil. Both transmitter and receiver coils were constructed using Litz wire to reduce resistive losses from proximity and skin effects. The receiving coil is connected to the second half of the transformation network, a series or parallel capacitor, and followed by a rectifier and a receiver load. It is found that the series-series topology is best for midrange power transfer. Both coils have the same size of 1 m x 1 m and use six turns of 48 AWG Litz wire on each.

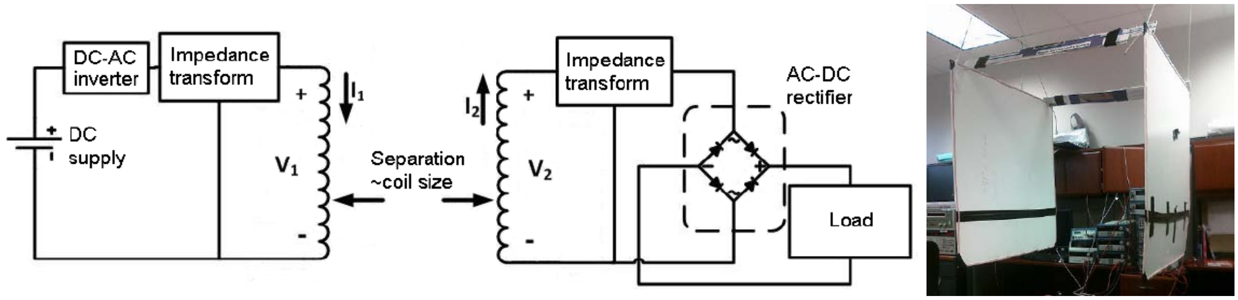

Fig. 1: Wireless electric energy delivery system diagram and picture of test setup (coils are wound around the while cardboards separated by 1 m).

II. Test Results

Fig. 2 shows measured efficiency versus delivered power when load resistance changes from 75Ω to 18Ω. The peak efficiency is about 57.9% and the peak power delivery is about 3.78 W. Transmitted power was measured using a current probe (Agilent N2783A), a voltage probe (Agilent N2863A), and an oscilloscope (Agilent DSO 5034A). The accuracy is estimated to be around 5%. Received power was measured using a DC electronic load (BK 8500). The estimated accuracy for received power is about 0.8%.

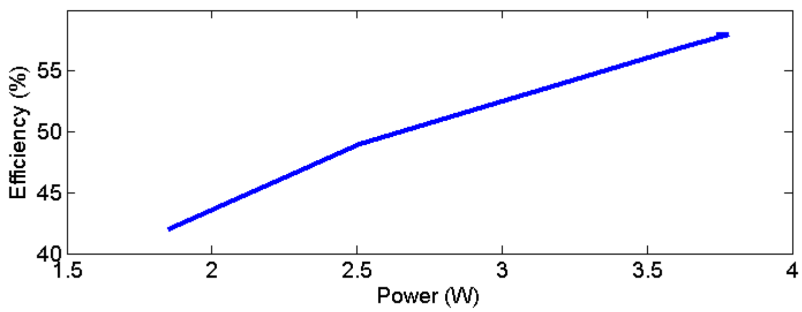

Fig. 2: Efficiency versus power of wireless electric energy delivery system.