PRELIMINARY RESULTS ON A MAGNETIC FIELD RESONANT WIRELESS POWER TRANSMISSION USING MATCHING AND AUXILIARY COILS

No.2218279 Rikuya Hokazono
(Supervised by prof. Shougo kiryu)

ABSTRACT

In recent years, wireless power transmission has attracted attention as a method of supplying power to medical devices in the body. In this study, we propose a magnetic resonance type wireless power transmission using an auxiliary coil sewn into a garment and a coil to match the impedance of the circuit. The auxiliary coil is sewn into the garment and the matching coil is placed on the side of the power transmitter coil. The system is envisioned to supply power to an implantable medical device while the patient is lying on a bed. The auxiliary coil is used as a relay to improve the coupling coefficient between the transmitter and receiver. Matching coils are installed to prevent reflection of electricity due to impedance mismatch. The conditions for efficient power transmission were studied using simulation software. Transmission efficiency depends on the coupling coefficient k and Q value of the coils. Therefore, the coupling coefficient between each coil was simulated. The distance between the auxiliary coil and the matching coil was set to 180 mm, and the outer diameter of the matching coil was changed to obtain the conditions under which the coupling coefficient increases. As a result, the coupling coefficient was largest when the outside diameter of the matching coil was 600 mm.

For the transmission coil and matching coil, the coupling was strongest when the outer diameters and pitches of both coils were equal. Simulation of transmission efficiency also showed that the highest transmission efficiency of 82.8% was achieved when the outer diameter and pitch of both the transmission and matching coils were set to 600 mm and 90 mm, respectively.

Based on the above simulation results, it was decided to fabricate the outer diameters of the transmission and matching coils at 600 mm, the auxiliary coil at 200 mm, and the receiving coil at 40 mm. The measurement of these coils showed that the design value of the inductance of the transmission coil was 7.26 μH, while the measured value was 24.2 μH, which was much higher than the design value. The loss resistance was also considerably larger at 1.37 kΩ. Therefore, we reduced the number of coils on the power transmission side and increased the number of Litz wires used to fabricate the coils to two, and found that the loss resistance of the transmission coil and matching coil could be significantly reduced to 26.8 Ω and 19.1 Ω, respectively. The inductance of the transmission coil was also reduced to 6.77 μH and that of the matching coil to 5.80 μH, which is close to the ideal values.