PRELIMINARY RESULTS ON ANALYSIS AND EVALUATION OF SEWN AUXILIARY ANTENNAS IN ELECTROMAGNETIC WAVE TYPE WIRELESS POWER TRANSMISSION SYSTEM FOR IMPLANTABLE DEVICES

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ABSTRACT

Recently, wireless power transmission has been attracting attention as a method of supplying power to medical devices inside the body. For instance, an artificial heart requires several tens of watts, necessitating power supply via a cable. However, wired power transmission, connected to the device through the patient's skin, poses a significant risk of infection. This study aims to address this medical concern by developing a wireless recharging system to alleviate the burden on patients with artificial hearts. As a use case, we propose a permanent power transmission system utilizing an array system to focus radio waves on a receiver within a limited space, such as a hospital or patient's room. Despite various methods for wireless power transmission, we have adopted the radio wave radiation type, capable of stable power supply over long distances. The envisioned transmission system comprises a three-antenna configuration: a wall-mounted power transmitting antenna, a body-implanted power receiving antenna, and an auxiliary antenna sewn into clothing to act as a repeater. In this study, the finite element method simulation software Femtet was employed to calculate transmission between the auxiliary and power receiving antennas under conditions of air and copper as antenna materials. Initially, the shape of the auxiliary antenna was simulated, identifying the Vicsek fractal antenna as the most suitable shape for integration. Subsequent simulations were conducted on the receiving antenna, resulting in the selection of a spiral shape with a resonant frequency of 144 MHz. Further simulations between the auxiliary and receiving antennas confirmed that physical proximity led to mutual interference, causing a drop in the resonant frequency. Subsequent simulations considered a human body environment, revealing changes in resonant frequency and S-parameter of reflection loss compared to transmission in air. The presence of a human body affected the receiving antenna placed inside the body model, while the auxiliary antenna outside remained relatively unaffected. However, the resonant frequency of transmission loss showed minimal change at 145 MHz, suggesting the human body's limited impact on transmission loss. Given the study's focus on feeding power to an artificial heart, the slight influence on the human body is crucial, considering it as a potential matter of life or death. Therefore, the next steps involve building an actual device and conducting measurements to develop a reliable power transmission system, accounting for factors such as changes in auxiliary antenna shape and the distance between auxiliary and receiving antennas, beyond the influence of the human body.