Novel Interference Voltage Measurement for Beam-Type Wireless Power Transfer using Electro-Optic Converter for Active Implantable Medical Device EMI Assessment

Takashi Hikage* (1), Suzune Ito (1), and Atsuki Ohtsuka (1)
(1) Faculty of Information Science and Technology, Hokkaido University,
Kita14, Nishi9, Kita-Ku, Sapporo, Hokkaido, 060-0814 Japan
e-mail: hikage@wtemc.ist.hokudai.ac.jp

The EMI on active implantable medical devices (AIMDs) such as implantable-cardiac pacemakers and cardioverter defibrillators (ICDs) is one of the most important issues needing investigations [1]. In this paper, we develop an interference voltage sensor for AIMD-EMI assessment by using direct modulated Electrical to Optical (EO) converter. Furthermore, measurements of interference voltage of a pacemaker in RF frequency band for beam type wireless power transfer (RF-WPT) using the measurement set-up are demonstrated.

EMI impacts pacemakers/ICDs when the sensing circuit of the pacemakers receives a signal similar to "an electrocardiogram signal" or "noise," and the signals' strength is higher than the sensing threshold level of the pacemaker/ICD. The induced voltage on internal circuit of the pacemaker/ICD by the received external signal is defined as "interference voltage". If the interference voltage exceeds the pacemaker's/ICD's sensing threshold level, it may occur malfunction.

We developed a novel interference voltage sensor by installing small-sized EO converter [2, 3] in the pacemaker CAN with a perfect waterproof structure. Figure 1 shows configuration of the developed interference voltage sensor. This sensor allowed to be connected an actual pacemaker lead in uni-polar mode and could measure induced voltage without disturbing electromagnetic fields because I/O signal of the sensor were made through optical fiber. Using the developed sensor placed into the torso-phantom, we measured interference voltage due to beam type WPT base-station emitting 900 MHz band electromagnetic waves. Such as frequency characteristics, polarization dependency, and non-liner response of the interference voltages due to RF-WPT operating at 915 MHz were measured under near-field exposure condition. Measured results confirmed the developed sensor can obtain interference voltage precisely. In the future, the developed set-up can be applied for other wireless systems.

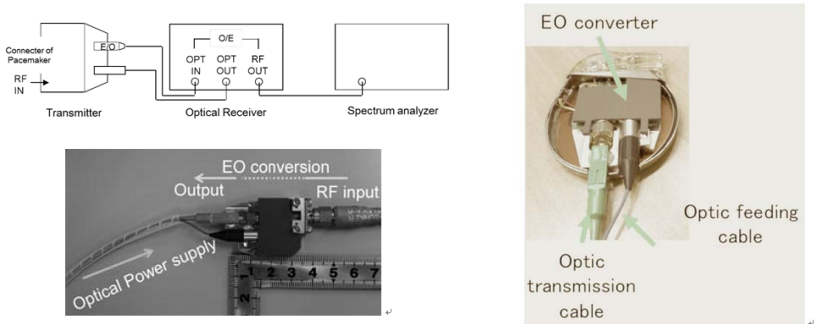

Figure 1. Electrical to Optical (EO) converter and developed interference voltage sensor

Acknowledgement
This work was partially supported by Grant-in-Aid for Japan Society for the Promotion of Science (JSPS) KAKENHI Grant Number JP 19K04504.

References

[1] W. Irnich, L. Batz, R. Muller and R. Tobisch, "Electromagnetic interference of pacemakers by mobile phones," J. Pacing and Clinical Electrophysiology, vol. 19, no. 10, pp.1431-1446, Oct. 1996.
[2] N. Tanaka, T. Hikage, T. Nojima, T. Iyama, J. Higashiyama, and T. OnishiI," Novel Interference Voltage Sensor Using an Electro-Optic Converter for Active Implantable Medical Devices EMI Assessment," proc. of First PEM International Workshop in Kyoto, FCA-8, pp.1-2, Nov. 2015.
[3] S. Ito, J. Sun, T. Hikage, J. Higashiyama, and T. Onishi:" Interference Voltage Measurement Set-up for Beam-Type WPT Using an Electro-Optic Converter for Active Implantable Medical Device EMI Assessment," proc. of 3rd PEM International Workshop in Ise (PEM2019), PE-10, pp.1-3, Nov. 2019.