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Professor Yun-Su Kim's research team develops high-efficiency wireless charging system technology by using artificial intelligence

▫ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) Graduate School of Energy Convergence Professor Yun-Su Kim's research team developed a technology for designing the shape of a wireless charging core with a magnetic induction method based on artificial intelligence.

◦ The research team applied artificial intelligence for the first time to design the core shape, creating the core shape design by using an artificial intelligence algorithm to increase the efficiency of the wireless charging system.

▫ For the magnetic induction type wireless charging system, the core affects the distribution of magnetic flux (bundle of magnetic lines of force) between the transmitter and the receiver, and the distribution of magnetic flux affects the performance of the wireless charging system. However, because it is not possible to obtain an optimal structure for the shape of the core mathematically, most of a core's shape in the past used a simple planar structure that makes the most of a given space being used, and studies on the design of the core shape are very scarce.

- The research team expressed the space where the core would be placed in a matrix in the artificial intelligence algorithm for it to learn the shape of the core, and the algorithm first designed shapes at random when starting to learn. The algorithm performs a simulation by calculating the magnetic flux table based on the designed shape and inputs the simulation results into the artificial intelligence algorithm. The artificial intelligence learned that a structure could predict performance by outputting the core shape after learning.

□ However, the research team modified the structure of the output to derive a structure with good performance. Instead of learning the wireless charging performance index as a single output, they added virtual outputs so that the number of outputs is the same as the number of inputs (core shape). By doing this, it was possible to select the location to place the core material by selecting the outputs with the highest performance indicator after learning.

- The research team confirmed by simulation and experiment that even if only 3% of the number of shapes that can be derived through artificial intelligence learning is applied, the performance (connection coefficient) is improved by about 7-10% compared to previous ones. The proposed technology was applied to the electric vehicle wireless charging system to reduce the material and weight of the core, and the result of the application resulted in an increase in efficiency of about 0.5%, although the material and weight of the core were reduced by 10% compared to the previous one.

□ Professor Yun-Su Kim said, "For the first time, the possibility of developing an optimal wireless charging system by utilizing artificial intelligence in designing a suitable core shape design for the wireless charging was confirmed. Currently, we are conducting research on the design of rechargeable batteries and wireless charging modules for human implantable electronic devices. In the future, this research will be applied to various fields where wireless charging is used in the future to increase efficiency and help reduce costs."

□ This research was conducted by GIST Professor Yun-Su Kim's research team with support from the "R&D project for commercialization of GIST science and

technology application group" and the "Energy AI convergence research and development project of the Information and Communication Industry Promotion Agency" and two papers were published: one in December 2020 in *IEEE Transactions on Industrial Electronics*, which is a journal in the top 1.6% (rank: 1/64) and the other in September 2020 in *IEEE Access*, which is in the top 22.4% (rank: 35/156) in the field of computer science and information systems.

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