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Multi-Input, Long-Distance, HTS-Based Wireless Charging System for Undersea Sensor Networks

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With ever-increasing requirements in a wide area of detection and high accuracy of measurement, it is necessary for the sensor networks to be built with extensive coverage and often installed in some places that are tough to be reached, such as underground or underwater. Under these circumstances, the costs of periodical maintenance can be extremely high. To solve this problem, a multi-input, high-temperature superconductor (HTS) based wireless charging system has been proposed for undersea sensor networks. With proper current control of multiple transmitters and the use of HTS coils, the wireless power transfer distance can be over 10 times longer than that of the existing system. Consequently, the proposed system makes it possible for the undersea sensor networks with a depth of over 200 m to be recharged with both convenience and flexibility.
In the proposed system, the transmitter currents can be synchronously overlaid for the concerning target. Not only the resonant voltages can be effectively dropped, but the allowable transmitter current will also be increased, and thus the output power can reach the satisfied level. On the other hand, the proposed current control strategy can also meet the requirement of great fault tolerance ability in long-range wireless charging procedures.
Hence, it is particularly attractive to install the proposed system in one or several working ships to remotely charge a large area of undersea sensor networks. Both finite element analysis of the full-scale system and practical experimentation of the reduced-scale system are conducted to evaluate the viability of the proposed system. The proposed system can tremendously reduce the cost for undersea operation of battery replacement for the sensor nodes. This work was fully supported by a grant (Project No. T23-701/20-R) from RGC, Hong Kong, China.

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