ABSTRACTS (MASTER THESIS)

Study on microwave power transmission systems in multipath environments

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This paper describes that retrodirective systems improve the efficiency and safety of microwave power transmission (MPT) system in multipath environments. The retrodirective array antenna sends back the phase conjugate signal toward the pilot signal transmitted from the receiver (Fig.1). In indoor environments, multipath waves are generated by reflection from objects and propagate as well as the direct wave between the transmitter and the receiver. Using array pattern synthesis calculation, we confirmed that the beam pattern of the retrodirective signal reproduces the multipath of the pilot signal and completely conforms with the optimal beam pattern calculated by the rotating element electric field vector (REV) method. Next, electromagneticfieldsimulationverifiedthattheretrodirectivesignalformedmultibeams, concentrated at the receiver and improved the MPT efficiency. Even if there is an obstacle between the transmitter and the receiver, the retrodirective signal could track the receiver, avoiding direct exposure of the obstacle from the beam (Fig.2). Furthermore, it was found that the MPT efficiency of the retrodirective was further improved by using not only the phase information but also the amplitude information of the pilot signal. When there were two receivers, the retrodirective signal could track each target simultaneously with separate multi-beams. By adjusting the phase difference between the two pilot signals, the retrodirective signal that maximizes the received power could be estimated. Finally, we experimentally demonstrated the retrodirective MPT system by fabricating and combining antennas and phase conjugate circuits (Fig.3). By using two orthogonal polarization, we tried to prevent interference between the pilot and retrodirective signals. Measured efficiency agreed with the simulation results (Fig.4), and it was confirmed that the system operates correctly in actual environments.

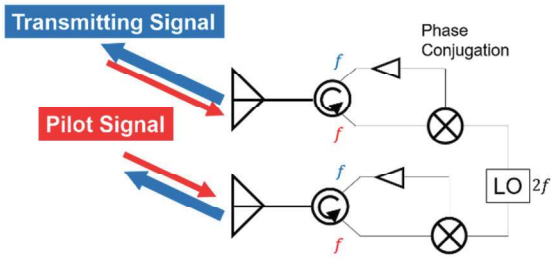

Fig.1. Principle of hardware retrodirective

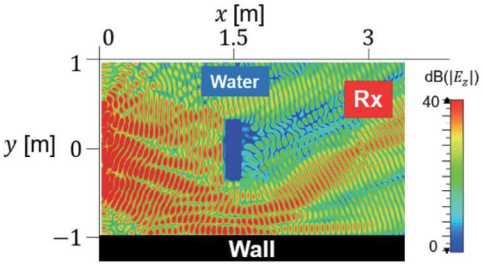

Fig.2. Power signal distribution of retrodirective using amplitude information

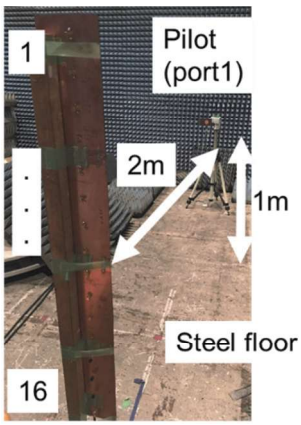

Fig.3. Experimental setup of multi-pass retrodirective

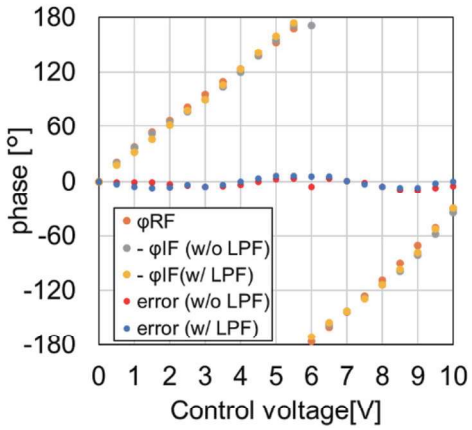

Fig.4. Measured data of phase conjugation