Development on an outdoor model of microwave power transmission with a software retrodirective system

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Microwave power transmission is a useful way to send electric power from place to place. We can transmit electric energy wherever we want by microwave. Accurate beam direction control is important for microwave power transmission. One of the ways for the accurate beam direction control is a software retrodirective system.

In the software retrodirective system, firstly we estimate DOA (Direction of arrival) and transmit microwave to the direction. We developed software retrodirective system to make outdoor microwave power transmission experiments.

First, we conducted experiments to estimate DOA in an anechoic chamber. We sent a pilot signal from a patch antenna to power transmitting site. The frequency of the pilot signal was 5.815GHz. We received it by four patch antennas and calculated the DOA. The distance between the transmitter to the receiver was 3.79 meters long. Errors of the DOA estimation were less than 1.2 degree. We successfully estimated the DOA with high accuracy.

Second, we conducted experiments about microwave power transmission with a software retrodirective system. We used 16 patch antennas for a power transmitting part and one for a receiving part. The frequency was 2.46GHz. We used four patch antennas for a DOA estimating part and one for a transmitting part. The frequency was 5.815GHz. We changed DOAs and transmit microwave to the estimated directions. Receiving power is ideally constant in any directions. The results of the receiving power were nearly constant in any directions. The difference of the receiving power was under 2dB. We realized accurate microwave power transmission with the software retrodirective system.

Finally, we considered improvement parts of our system. Two important points are necessary to be improved. One is computational speed of the DOA estimation, the other is noise durability about pilot signal. To solve these problems, we proposed DOA estimation with Fourier Transform and using a Spread Spectrum signal for the pilot signal.