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AUTOMATIC REMOTE ARRAY CALIBRATION SYSTEM FOR MICROWAVE WIRELESS POWER
TRANSMITTER**Abstract**

When developing and testing a phased array system, it is necessary to know the initial amplitude and phase to find the additional phase values required for the desired beam steering; this is called calibration. In the case of the wireless power transmission (WPT) system, unlike the array antenna system of the radar, a power receiver exists at a remote place. Using this receiver as a measuring point enables precise calibration, including the transmission path, when phase imbalances occur during operation. It can also respond to physical path changes caused by obstacles as well as hardware imbalance due to vibration or heat. However, if the number of array antennas is large, calibration time is extended because the measurement, control, and calculation processes are required for every channel. In addition, remote calibration of the microwave power transmitter (MPT) array for a moving target requires high-speed data communication and synchronization between the transmitting and receiving devices. A system that can quickly and automatically calibrate the entire MPT array was developed. The rotating element electric-field vector (REV) method was used, which measures only the amplitudes of signals at the power-receiving location. A reference signal transmitter (RST) capable of fast phase rotation has been manufactured, replacing one of the four channels of an MPT module. In addition, a calibration signal detector (CSD) was fabricated to measure the synthesized waveform of the reference channel and the under-test channel signal at the receiving position. In order to check the developed system's operation in the laboratory, the reference and under-test outputs of the new MPT module were combined by the Wilkinson combiner and input to CSD. When the reference signal's phase was rotated at a speed of 10 kHz, the calibration signal was synthesized properly and measured well. The hardware of the proposed remote array calibration system was applied to a low-weight wireless power transmission system (5.8GHz, 96ch, 50W/ch, implemented in 2021), and the calibration software was integrated with the control program of the MPT system. The entire MPT array was successfully auto-calibrated using the CDS at 15 m in an anechoic chamber and also done outdoors with the CDS at 50 m. The whole calibration could be completed within 3 minutes using Ethernet wired communication and 4 minutes using 922 MHz wireless communication. Decreased beam width and increased power density were confirmed after the calibration.