Study on cylindrical near-field measurement system for 5G band using RoF and multi-probes

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In fifth mobile communication systems (5G), massive MIMO that enables high capacity and high reliability communication by combining the employing massive antennas with beamforming at the base station has been proposed. Massive MIMO in the base station is composed of 100 or more antennas in a two-dimensional arrangement. The direction of beamforming and the beam width are issues, because the beamforming must be realized for various directions. Therefore, measurement with a three-dimensional beam pattern is essential for the evaluation on massive MIMO.

To measure a three-dimensional pattern by conventional far field measurement, a large-scale measuring system is required. In 5G, the use of a higher frequency is considered, the free-space propagation loss in the measurement and the transmission loss in the device such as a cable also increase, and the dynamic range narrows.

In this paper, near-field measurement system using Radio over fiber (RoF) and multi-probes is proposed. Fig. 1 shows the diagram of the proposed measurement system. There are 16 receiving probes with Electro-Optical (EO) conversion. These are connected to the optical switch. The receiving probes are switched by the optical switch. Then the near-field is measured by network analyzer via Optical-Electro (OE) conversion. This system obtains 96 measurement points by moving the probes 5 times along the vertical direction. The moving spaces are 0.5λ. The measurement system reduces the free-space propagation loss by measuring the near-field and reduces transmission loss in the device by using RoF. In addition, the system shortens measurement time by using multi-probes. Hence, the measurement system realizes with low cost.

The prototype of the system is developed for 13GHz band. In the measurement for a planar patch array antenna of 64 elements, the direction of beam and the beam width almost agree with the result measured in the far-field. The estimation method is used cylindrical near field (CNF) to far field transformation. The footprint size is 1000×500mm. Despite such compactness, it is shown that the system can obtain almost the same result compared with the conventional method.

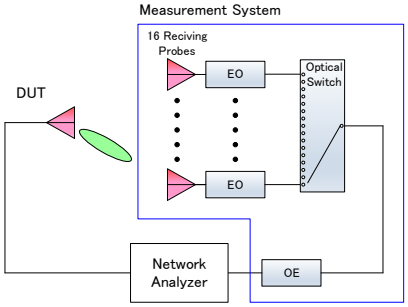

Figure 1. Diagram of proposed measurement system