A Low-Cost Antenna Diversity Assessment System for MIMO Antennas

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In this work, a low cost antenna measurement system applicable for antenna diversity assessment is proposed. The objective is to provide a convenient and cost-effective measure to assess the effective diversity gain (EDG) performance of a multi-antenna system. There are different methods for evaluation of antenna diversity, which is essential to the multiple-input multiple-out (MIMO) performance. For example, the envelop correlation coefficient (ECC) defined in terms of S-parameters of a multi-antenna system can be used to examine the isolation among antennas, while the ECC defined in terms of radiation patterns can be calculated to ensure dissimilar pattern characteristics. Nevertheless, the EDG is the most critical metric because it addresses both the antenna pattern features and antennas' interaction with the propagation environment. However, though the EDG measurement is doable, the manual measurement process, which requires the operator to record the readings from multiple spectrum analyzers, is time consuming and labor intensive. As a result, a semi-automatic measurement system is proposed to save man power and speed up the EDG evaluation process.

The system is divided into a transmitting end and a receiving end. The transmitter is formed by a signal generator and a half wavelength dipole to provide a continuous wave source. The receiving end comprises a control computer, a data acquisition card with multiple analog I/O ports, a number of RF power detectors, and a reference half wavelength dipole. Antennas of a system-under-test are connected to power detectors. A control program based on LabView is coded to scan power detector readings periodically. The readouts are then converted to RF power levels in dBm. The reception end equipment is loaded on a push cart and moved slowly in a multi-path rich environment to collect samples. By setting the sampling interval as one second and changing the transmitter location as well as its orientation for every 100 samples, the measurement time for 1200 samples is approximately 30 minutes. To demonstrate the validity of this approach, a four-antenna system proposed for WLAN AP [1] is measured with the system. The EDG value achieved with the selection combination method is 11.6 dB, which is 2 dB smaller than the simulated EDG using the maximum ration combination method.

[1] W.-J. Liao, C.-Y. Hsieh, B.-Y. Dai, B.-R. Hsiao, "Inverted-F/slot integrated dual-band four-antenna system for WLAN access points," Accepted by *IEEE Antenna Wireless Propag. Lett.* on Dec. 6, 2014.

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