MIMO Transmission for Single-Fed ESPAR With Quantized Loads

Abstract:

Compact parasitic arrays in the form of electronically steerable parasitic antenna radiators (ESPARs) have emerged as a new antenna structure that achieves multiple-input-multiple-output (MIMO) transmission with a single RF chain. In this paper, we study the application of precoding on practical ESPARs, where the antennas are equipped with load impedances of quantized values. We analytically study the impact of the quantization on the system performance, where it is shown that while ideal ESPARs with ideal loads can achieve a similar performance to conventional MIMO, the performance of ESPARs will be degraded when only loads with quantized values are available. We further extend the performance analysis to imperfect channel state information. In order to alleviate the performance loss, we propose to approximate the ideal current vector by optimization, where a closed-form solution is further obtained. This enables the use of ESPARs in practice with quantized loads. Simulation results validate our analysis and show that a significant performance gain can be achieved with the proposed scheme over ESPARs with quantized loads. Finally, the tradeoff between performance and power consumption is shown to be favorable for the proposed ESPAR approaches compared with conventional MIMO, as evidenced by our energy efficiency results.