Power-Combining Antennas for LINC Transmitters

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To make future mm-wave wireless communication more efficient in terms of transmit power, we apply the concept of Linear Amplification using non-Linear Components (LINC) (F. P. van der Wilt, E. Habekotté and A. B. Smolders, IEEE Trans. on A&P, 2016, 64(2), 761-766). A LINC system includes a signal component separator which separates its input signal with varying envelope modulation like 64QAM into two constant-envelope streams. Because the envelope variation is eliminated, each of both streams can then be amplified by a highly nonlinear power amplifier (PA) without the occurrence of significant spectrum broadening. This enables the use of highly efficient nonlinear PAs such as the class-E or class-F types. In a conventional LINC system the two resulting amplified signals are typically recombined in a Wilkinson combiner and the resulting output signal is transmitted by a standard antenna as shown in Figure 1. Problem with this method is the substantial power loss that occurs inherently in the Wilkinson combiner. In our approach this loss is avoided by directly combining the two streams in the transmit antenna thus eliminating the Wilkinson combiner, see Figure 2. In addition to the reduction of power loss this would enable the integration of the antenna with the front-end PAs reducing size and cost of the radio frequency section.

In this publication we propose three new power-combining antenna configurations which we tested in a complete LINC setup. A mutual comparison is made in terms of (simulated and measured) return loss, port isolation, antenna efficiency and radiation pattern/antenna gain of our antenna designs. In addition we present, discuss and compare the quality of signal transmission that we obtained with our LINC transmit antennas. For this, we transmitted 64QAM-modulated signals via our antennas and we measured the error vector magnitude as well as the spectrum broadening of the signal as received in the far-field and in different directions with respect to the transmit antenna orientation. To benchmark our designs, in particular as regards the obtained overall gain in power efficiency, we also include a comparison with the conventional system based on Wilkinson combining as reference.

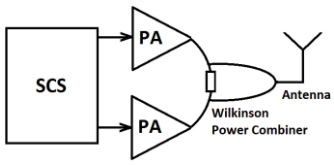

Figure 1: Conventional LINC implementation.

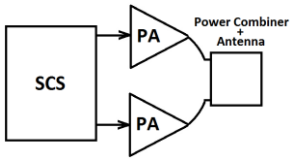

Figure 2: LINC with a power-combining antenna