Characterization and modeling of RF amplifiers with multiple input signals

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I. INTRODUCTION

The increasing need for higher data rate and efficient power usage in telecommunication is pushing for the use of radio frequency (RF) power amplifiers (PAs) with multiple signals [1]–[3]. In these multi-carrier, multi-signal scenarios, the RF PA concurrently amplifies all the input signals. In addition to the nonlinear distortions present in the SISO PAs, the multi-carrier scenario presents both inter-modulation (IM) and cross-modulation (CM) distortion [1], [2]. Hence, the characterization and mitigation of these distortions is of primary importance for the efficient operation of RF PAs with multiple input signals. Conventional two-tone test [4] results can be presented vs tone spacing and amplitude level; deviations from a flat surface indicate nonlinear dynamic effects. In [2] a conventional two-tone test is extended to concurrent dual-band PAs and the test results were used to modify a behavioral model, which was found in experiments to improve the in-band and out-of-band errors.

II. RESULTS

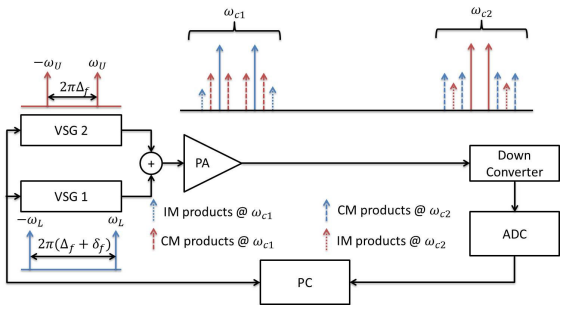

Fig. 1. Measurement setup for the characterization of concurrent dual-band power amplifier [2].

Fig. 1, shows the measurement setup used for the characterization of a concurrent dual-band PA [2]. Each band was excited with a two-tone signal with varying tone spacing. The dual two-tones were swept both in amplitude and frequency to revel nonlinear and dynamic effects in IM and CM products. Fig. 2 shows the Asymmetric energy surfaces of 3^{rd} order IM and CM products. Notice that the CM products have different behavior than the IM products, which indicates that the memory effects that contributes to asymmetry are different in the CM products than in the IM products. These results were used to modify existing behavioral models [3]. Fig. 3 shows the model error spectra of modified model and the one before modification [3].

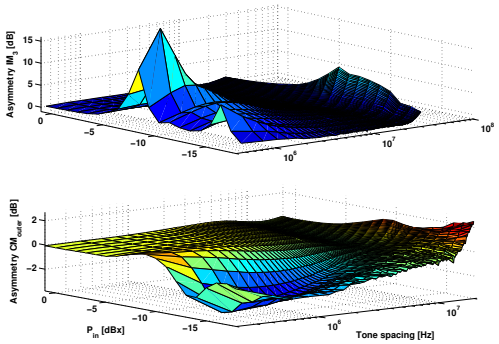

Fig. 2. Asymmetric energy surface between lower-upper IM products (top). Asymmetric energy surface between lower-upper CM products (Bottom) [2].

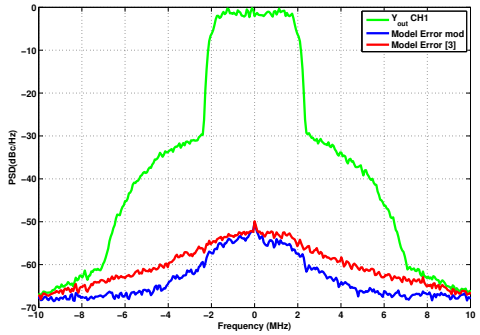

Fig. 3. Signal spectrum (green) and error spectra for the original model (red) and the model modified based on the result from the dual two-tone test [2].

III. CONCLUSIONS

A characterization technique for RF PAs excited with multiple signals is presented. The technique can be used for characterization of memory effects in IM/CM products. The extracted information can in return be of use for modifying behavioral models to better capture memory in IM/CM products.

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