On the Predistortability of High Efficiency Multi-carrier Power Amplifiers for Wireless Communication Infrastructure

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Digital predistortion is being widely used to linearize multi-carrier power amplifiers (PAs) for wireless communication infrastructure. Indeed, among the currently available linearization techniques and advanced power amplification architectures, digital predistortion of Doherty power amplifiers achieves the best possible compromise in terms of linearity performance and power efficiency for multi-carrier applications up to 20 MHz bandwidth. However, as the bandwidth of the transmitted signal increases, memory effects become unavoidable and often limit the linearizability of highly efficient PAs. Accordingly, it is highly important to quantify the memory effects intensity in power amplifier prototypes to compare different circuit topologies or semi-conductor technologies [1][2]. This can be beneficially used to tune the PA circuit and / or choose the appropriate device technology in order to minimize its memory effects from early design stages.

Memoryless postcompensation technique is a neat approach for memory effects quantification. Indeed, only a single set of measurements for the acquisition of the baseband complex waveforms at the input and output device under test (DUT) is necessary. The measured data is then processed within a simulation environment to accurately estimate the memory effects intensity. The measurements data post-processing consists in applying downstream of the power amplifier / transmitter a nonlinear function designed to cancel out the static nonlinearity exhibited by the DUT. The residual distortions are then mainly attributed to the memory effects. Memory effects intensity metrics were proposed in [3]. These are based on the integration of the residual power within a customizable bandwidth after applying memoryless postcompensation to the measured output data.

This presentation will discuss the critical issues related to the predistortability of high efficiency multi-carrier power amplifiers through the example of a high efficiency 300-Watt peak power Doherty amplifier driven by various WCDMA signals having bandwidths from 5 to 20MHz. The memoryless postcompensation is reviewed and key concerns related to the synthesis of the postcompensation function are addressed. Then, postcompensation is applied for memory effects intensity quantification. Figure 1 presents a simplified block diagram of the proposed approach for linearizability and also accurate model performance evaluations. Indeed, the precision of frequency domain assessment of forward models is usually limited by the contribution of the static nonlinearity to the behavior of the DUT which buries the memory effects contribution. Finally, the integration of memoryless post-compensation and memory effects intensity measurement within an automated test environment for power amplifiers / transmitters characterization and linearizability assessment is demonstrated as illustrated in Figure 2.

References

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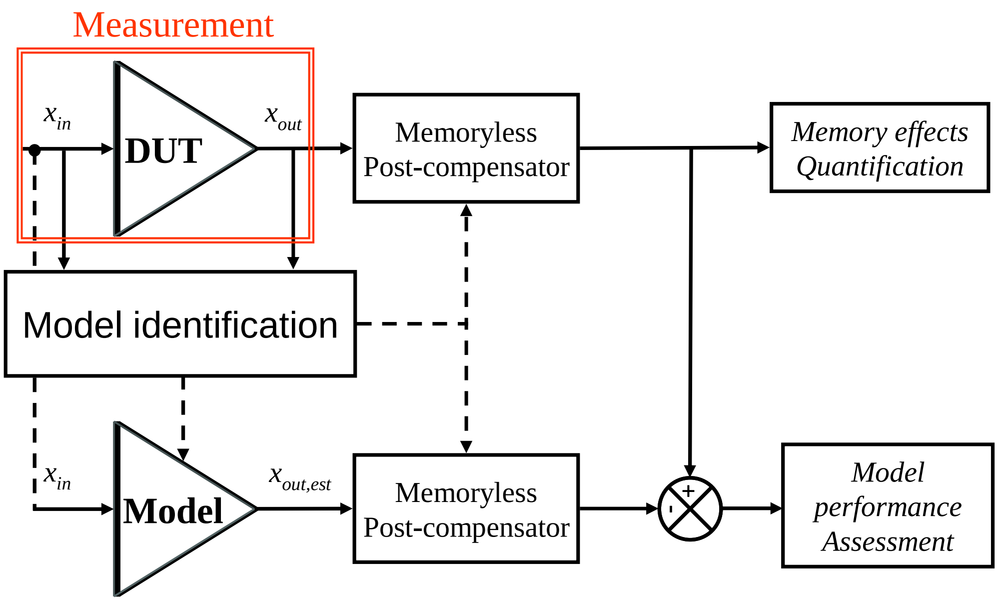

Figure 1. Proposed approach for linearizability and model performance assessment

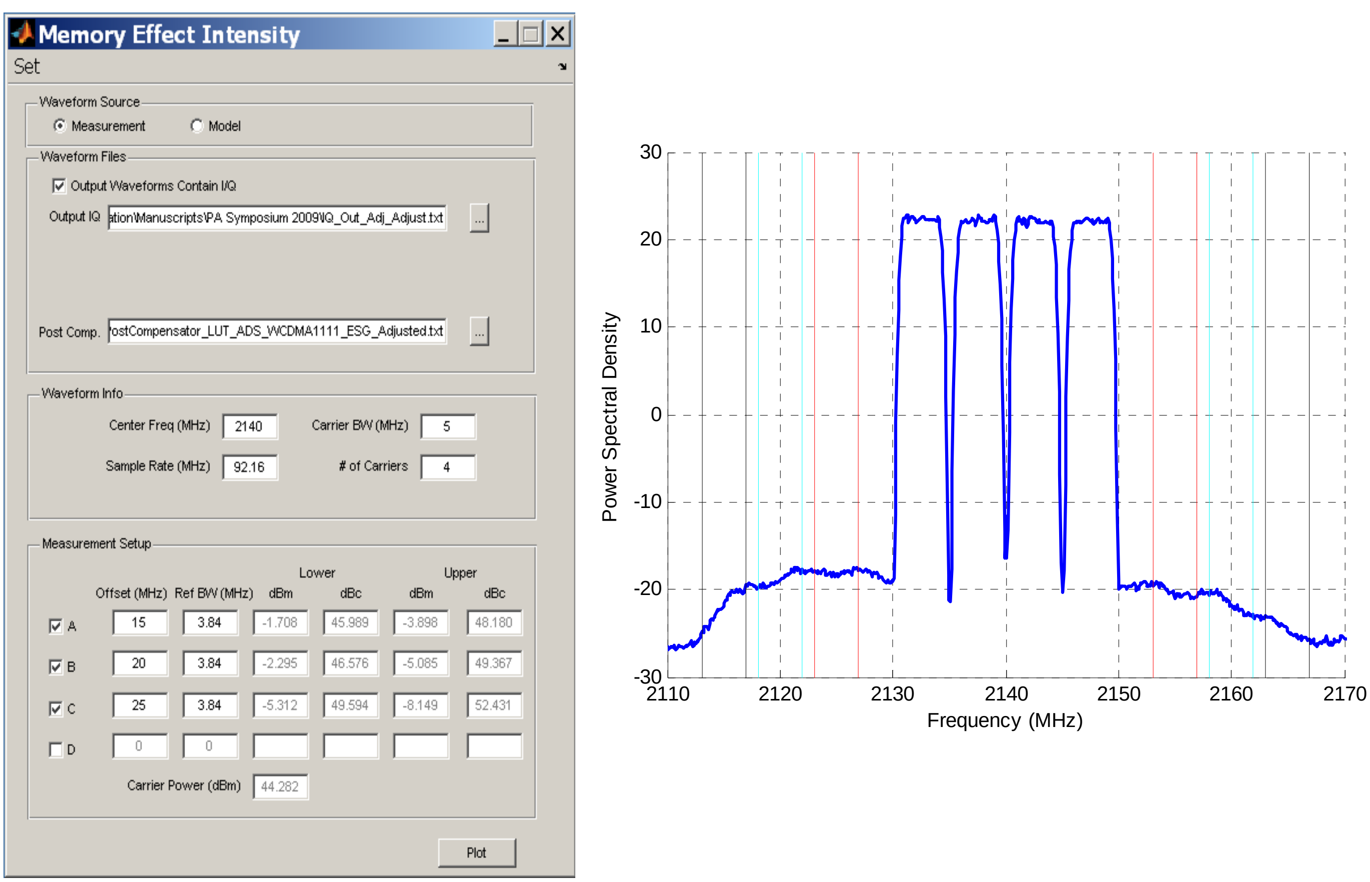

Figure 2. Automated test environment for memory effects intensity quantification