Transmission Observation Receiver

Popular Science Summary
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The need for very high data rates and capacities in the modern wireless communication systems requires wide band transmit signals in the base stations. This large bandwidth makes the design of the power amplifier(PA) challenging. The power amplifier is an essential part of any transmitter to convert the signal in to higher power and drive the antenna. For power amplifiers, there is a trade off between the bandwidth, linearity and energy consumption. Linearity here is a measure of the signal distortion due to non-linearities of the transistors which form the power amplifier. The need for energy efficiency in the base stations makes it necessary to find energy efficient linearization techniques. Transmission observation receivers(TOR) are often used for this purpose, where the transmitted signal is fed back to a linear TOR chain. The output from the TOR is then fed to a digital pre-distortion circuit (DPD) which is one of the advanced linearization techniques that compensates for nonlinear distortion in power amplifiers by creating a compensation signal that pre-distorts the input of the PA so that, the output appears non distorted and perfect. DPD allows PAs to be highly efficient without linearity degradation, which is nowadays one of the essential requirements in high-power wireless base stations.

The TOR is supposed to be very linear so as accurate compensation can be achieved later in the digital pre-distortion block. Also, since power amplifier is nonlinear, its output spans multiples of its input bandwidth because of harmonic distortion. This means that the TOR band should be wider to account for the whole significant signals.

In this thesis work, a wide band transmission observation receiver that handles different signal strengths and different frequency bands was designed. The circuit is composed of attenuator to reduce the signal level and then a mixer that down converts the signal from high frequency to low frequency to enable further processing in the subsequent blocks.

Linearity and power efficiency of the TOR were achieved by utilizing digital and passive architectures.

The results show that this TOR is very linear and applicable for a wide range of input frequencies ranging from 2GHz to 7GHz. The implemented circuit is yet to be integrated with a filter to filter unwanted frequencies and then it will be ready for layout and manufacturing in CMOS (Complementary Metal Oxide Semiconductor)technology.