Digital-Domain Signal Compensation for Hardware Non-Idealities in Sub-THz Commmunications

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Abstract— To enable ultra-high-rate communication services of 6G, simultaneously achieving hyper-wideband utilization of sub-THz spectrum and high signal quality is necessary. In this paper, therefore, we propose digital-domain signal processing techniques to compensate for non-ideal hardware-induced signal distortions in sub-THz communication systems.

Keywords— 6G, digital-domain processing, power amplifier nonlinearity, sub-THz communication, time-interleaved ADC.

Toward 6G high data rate wireless communication services, which demand up to hundreds of Gbps, provisioning hyper-wideband in the sub-THz spectrum becomes essential [1]-[3]. In addition to the wide communication bandwidth, obtaining high signal quality is critical for the ultra-high-rate communication services. However, as the bandwidth increases, practical hardware impairments cause signal distortions. As illustrated in Fig. 1, a transmitter and a receiver of a downlink sub-THz system can have diverse hardware non-idealities. One of the major signal distortions due to wide bandwidth usage at the transmitter, is induced from power amplifier non-linearity (PAN) of a base station (BS) [4]. At the receiver side, simultaneously, severe distortion is caused by mismatches of time-interleaved ADC (TI-ADC) of a user equipment (UE) [5], [6]. As proposed in [7], digital-domain signal compensation at the UE can exploit both low power consumption per computation and side-information of signal statistics from radio resource management of the sub-THz system. The optimal compensation filter can be achieved in the minimum mean square error (MMSE) sense with signal statistics. And the statistics, resulted by sharp and dynamic beam management of the sub-THz links [1], [8], can be obtained by a protocol between the BS and the UE. In this paper, we propose digital-domain signal compensation for non-ideal signal distortions of both PAN of the BS and TI-ADC of the UE.
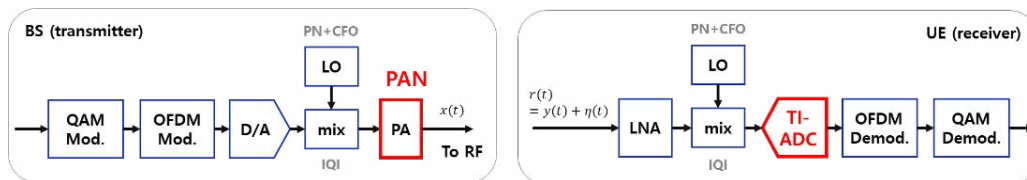

Fig. 1. Hardware non-idealities of a transmitter and a receiver of a sub-THz wireless communication system

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