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HPA Pre-Distorter Based on Neural Networks for 5G Satellite Communications

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Abstract : Satellites are becoming indispensable assets to fifth-generation (5G) new radio architecture, complementing wireless and terrestrial communication links. The combination of satellites and 5G architecture allows consumers to access all next-generation services anytime, anywhere, including scenarios, like traveling to remote areas (without coverage). Nevertheless, this solution faces several challenges, such as a significant propagation delay, Doppler frequency shift, and high Peak-to-Average Power Ratio (PAPR), causing signal distortion due to the non-linear saturation of the High-Power Amplifier (HPA). To compensate for HPA non-linearity in 5G satellite transmission, an efficient pre-distorter scheme using Neural Networks (NN) is proposed. To assess the proposed NN pre-distorter, two types of HPA were investigated: Travelling Wave Tube Amplifier (TWTA) and Solid-State Power Amplifier (SSPA). The results show that the NN pre-distorter design presents EVM improvement by 95.26%. NMSE and ACPR were reduced by -43,66 dB and 24.56 dBm, respectively. Moreover, the system suffers no degradation of the Bit Error Rate (BER) for TWTA and SSPA amplifiers.

Keywords : satellites, 5G, neural networks, HPA, TWTA, SSPA, EVM, NMSE, ACPR
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