Abstract

High frequency and high dynamic range continuous time filters

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Many modern communication systems use orthogonal frequency division multiplexing (OFDM) and discrete multi-tone (DMT) as modulation schemes where high data rates are transmitted over a wide frequency band in multiple orthogonal subcarriers. Due to the many advantages, such as flexibility, good noise immunity and the ability to be optimized for medium conditions, the use of DMT and OFDM can be found in digital video broadcasting, local area wireless network (IEEE 802.11a), asymmetric digital subscriber line (ADSL), very high bit rate DSL (VDSL) and power line communications (PLC). However, a major challenge is the design of the analog frontend; for these systems a large dynamic range is required due to the significant peak to average ratio of the resulting signals. In receivers, very demanding high-performance analog filters are typically used to block interferers and provide anti-aliasing before the subsequent analog to digital conversion stage. For frequencies higher than 10MHz, Gm-C filter implementations are generally preferred due to the more efficient operation of wide-band operational transconductance amplifiers (OTA). Nevertheless, the inherent low-linearity of open-loop operated OTA limits the dynamic range. In this dissertation, three different proposed OTA linearity enhancement techniques for the design of high frequency and high dynamic range are presented. The techniques are applied to two filter implementations: a 20MHz second order tunable filter and a 30MHz fifth order elliptical low-pass filter. Simulation and experimental results show a spurious free dynamic range (SFDR) of 65dB with a power consumption of 85mW. In a figure of merit where SFDR is normalized to the power consumption, this filter is 6dB above the trend-line of recently reported continuous time filters.