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Low-Voltage and Low-Power Bulk-Driven Continuous-Time Current-Mode Differentiator Filters

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Abstract : Emerging technologies such as ultra-wide band wireless access technology that operate at ultra-low power present several challenges due to their inherent design that limits the use of voltage-mode filters. Therefore, Continuous-time current-mode (CTCM) filters have become very popular in recent times due to the fact they have a wider dynamic range, improved linearity, and extended bandwidth compared to their voltage-mode counterparts. The goal of this research is to develop analog filters which are suitable for the current scaling CMOS technologies. Bulk-driven MOSFET is one of the most popular low power design technique for the existing challenges, while other techniques have obvious shortcomings. In this work, a CTCM Gate-driven (GD) differentiator has been presented with a frequency range from dc to 100MHz which operates at very low supply voltage of 0.7 volts. A novel CTCM Bulk-driven (BD) differentiator has been designed for the first time which reduces the power consumption multiple times that of GD differentiator. These GD and BD differentiator has been simulated using CADENCE TSMC 65nm technology for all the bilinear and biquadratic band-pass frequency responses. These basic building blocks can be used to implement the higher order filters. A 6th order cascade CTCM Chebyshev band-pass filter has been designed using the GD and BD techniques. As a conclusion, a low power GD and BD 6th order chebyshev stagger-tuned band-pass filter was simulated and all the parameters obtained from all the resulting realizations are analyzed and compared. Monte Carlo analysis is performed for both the 6th order filters and the results of sensitivity analysis are presented.

Keywords : bulk-driven (BD), continuous-time current-mode filters (CTCM), gate-driven (GD)
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