ABSTRACT

High Performance Continuous-time Filters for Information Transfer Systems. (August 2003)

Ahmed Nader Mohieldin, B.Sc., Cairo University, Egypt;

M.Sc., Cairo University, Egypt;

Chairs of Advisory Committee: Dr. Edgar Sánchez-Sinencio

Vast attention has been paid to active continuous-time filters over the years. The changes in technology have required new approaches. Thus as cheap, readily available integrated circuit OpAmps replaced their discrete circuit versions, it became feasible to consider active-RC filter circuits using large numbers of OpAmps, and new improved architectures emerged. Similarly the development of integrated operational Transconductnace Amplifier (OTA) led to new filter configurations and allowed practical solutions to problems using currents as the variables of interest, rather than voltages. That is trasconductance-mode. This gives rise to OTA-C filters, using only active devices and capacitors, making it more suitable for integration. The demands on filter circuits have become ever more stringent as the world of electronics and communications has advanced. In addition, the continuing increase in the operating frequencies of modern circuits and systems increases the need for active filters that can perform at these higher frequencies; an area where the LC active filter emerges. What

mainly limit the performance of an analog circuit are the non-idealities of the used building blocks and the circuit architecture. The research is concentrating on the design issues of high frequency continuous-time integrated filters.

Several novel circuit building blocks are introduced. A novel pseudo-differential fully balanced fully symmetric CMOS OTA architecture with inherent common-mode detection is proposed. Through judicious arrangement, the common-mode feedback circuit can be economically implemented.

On the level of system architectures, a novel filter low-voltage 4^{th} order RF bandpass filter structure based on emulation of two magnetically coupled resonators is presented. A unique feature of the proposed architecture is using electric coupling to emulate the effect of the coupled-inductors, thus providing bandwidth tuning with small passband ripple. Each resonator is built using on-chip spiral inductors and accumulation-mode PMOS capacitors to provide center frequency tuning.

As part of a direct conversion dual-mode 802.11b/Bluetooth receiver, a BiCMOS 5^{th} order low-pass channel selection filter is designed. The filter operated from single 2.5V supply and achieves 76dB of out-of-band SFDR. A digital automatic tuning system is also implemented to account for process and temperature variations.

As part of a Bluetooth transmitter, a low-power quadrature direct digital frequency synthesizer (DDFS) is presented. Piecewise linear approximation is used to avoid using ROM look-up table to store the sine values in a conventional DDFS. Significant saving in power consumption, due to the elimination of the ROM, renders the design more suitable for portable wireless communication applications.