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A New Concept of Gm Tuning Circuit for Voltage- or Current-Controlled Transconductance Circuits

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Akira Hyogo and Keitaro Sekine(Science University of Tokyo)

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Abstract

A new concept of a transconductance (Gm) tuning circuit using switched-capacitor (SC) circuits for voltage- or current-controlled transconductance circuits is proposed. This concept uses an integrator which is controlled by time (or frequency) as a current-to-voltage converter for tuning. The Gm can be determined by the integrated time of the current from the transconductance circuit, the integration capacitor and the reference voltage(s) . Moreover, the Gm control voltage produced by the proposed circuit has no ripple. The proposed circuit can tune operational transconductance amplifiers, MOS resistive circuits and so on. Finally, an offset voltage cancellation technique for the integrator is shown. SPICE simulations are performed to verify the performance of the proposed circuits.

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Key words: Automatic tuning circuits, Switched-capacitor circuits, OTA, Transconductors, MOS analog circuits, Circuit theory and design

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1. Introduction

A number of integrated analog signal processing circuits (e.g. integrated continuous-time filters, oscillators and so on) using operational transconductance amplifiers (OTAs)[1][2], MOSFETs as voltage-controlled resistors (e.g. MOS resistive circuits (MR[illegible])) have been proposed, recently. Because they ca[illegible] their electric characteristics (e.g. transcondu[illegible] off frequency) via voltages and/or currents[1].

However, it is difficult to implement the[illegible] time constant value which depends on C/Gm on a chip because it is affected by process parameter tolerances and temperature variations.

Thus, a Gm tuning system is required to keep correct time constants. A PLL technique has been studied for the tuning system[4]. But this technique has several drawbacks. One of them is that the system is complex. This means that application fields are limited.

In this paper, a new concept of a Gm tuning circuit (GTC) using switched-capacitor (SC) circuits for voltage- or current-controlled transconductance circuits is proposed. This conceptuses an integrator which is controlled by time (or frequency) as a current-to voltage converter (IVC) for converting from the output current of the tuned transconductance circuit (TC) to the voltage.

Therefore, the operation of the GTC is such that the charges proportional to the output voltage of the IVC and the reference voltage are transferred by SC circuits to the OPamp controlling the TC at the same time and the output current of the TC is controlled so that the sum of the charges is zero.

Thus, the charge flowing into the TC controlling OPamp becomes zero once the steady state is reached. Hence, the control voltage becomes constant. As a result, no ripple is generated.

The Gm can be determined by the integrated time of the current from TC, the integration capacitor and the reference voltage.

[illegible]is paper also shows that the proposed circuit (added [illegible]ters) can be widely used for the tuning circuits [illegible]rent-controlled OTA type transconductors or M[illegible]s (e.g. MRC).

Finally, an [illegible] technique for the integrator is discussed.

SPICE simulations are performed to verify the predicted performance of the proposed GTC.

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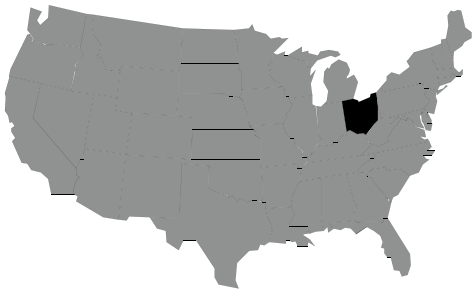

Fig.1 Location of Ohio state

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