A new CCII based sinusoidal oscillator employing grounded resistors and capacitors

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Abstract: *In this paper a new CCII-based double-element controlled sinusoidal oscillator employing grounded resistors and capacitors is presented. The oscillator topology provides entirely independent control of oscillation condition and oscillation frequency, suitability for VLSI realization due including only grounded passive elements. The circuit exhibits low active and passive sensitivities, voltage and current tracking error affects of the current conveyors can be eliminated easily with careful design. Theoretical results are confirmed with PSPICE simulations.*

References:

U. Çam, H. Kuntman, A new CCII-based sinusoidal oscillator providing fully independent control of oscillation condition and frequency, Microelectronics Journal, Vol.29, Nos.11, pp.913-919, 1998.

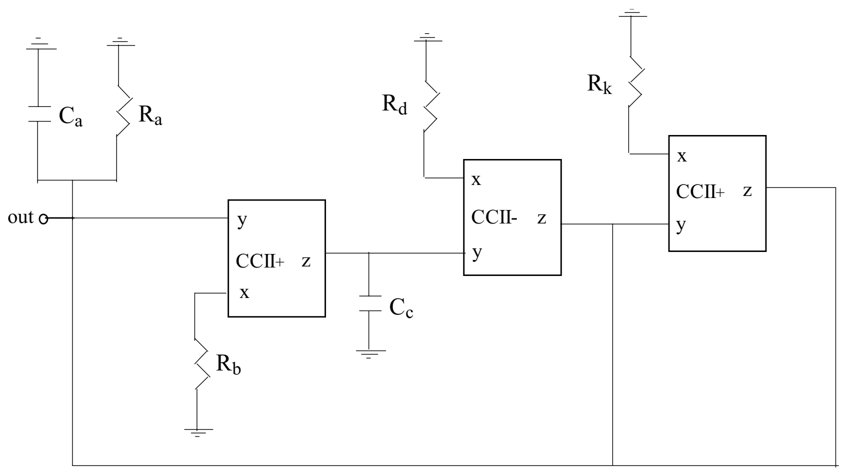

Figure 1: Proposed oscillator circuit

Oscillation condition and oscillation frequency are obtained as:

$$R_a = R_k$$

$$\omega_0 = \sqrt{\frac{1}{R_b R_d C_a C_c}} \qquad (6)$$

Oscillation condition and oscillation frequency are completely independent from each others.

Effect of CCII nonidealities: The dominant current conveyor nonidealities can be modeled as follows; $\iota_z = \pm\beta i_x$, $v_x = \alpha v_y$ where $\beta = 1-\varepsilon_i$, $\alpha = 1 - \varepsilon_v$ ε_i and ε_v denotes current and voltage tracking error respectively.

$$R_a = \frac{R_k}{\beta} \qquad \omega_0 = \sqrt{\frac{\alpha\beta}{R_b R_d C_a C_c}} \tag{7}$$

By choosing $R_{kn} = \beta R_k$, $R_{bn} = \alpha R_b$, $R_{dn} = \beta R_d$ CCII tracking errors can be eliminated easily.

Sensitivity Consideration: The relative sensitivity of oscillation frequency with respect to resistors R_b , R_d capacitors C_a , C_c and tracking errors ε_i , ε_v can be obtained as;

$$S_{R_b}^{\omega_0} = S_{R_d}^{\omega_0} = S_{C_c}^{\omega_0} = S_{C_a}^{\omega_0} = -0.5 \qquad S_{\alpha}^{\omega_0} = S_{\beta}^{\omega_0} = 0.5 \tag{8}$$

It is clearly observed from eqn.9 that the circuit has low passive and active sensitivity.

Simulation results: To confirm theoretical results, proposed oscillator circuit has been simulated using PSPICE program and simulation result is given in Fig.2. The circuit was constructed with the commercial current conveyor IC AD844 of Analog Device. Since AD844 is designed as CCII+, the CCII- was obtained by cascading two ICs where the X terminal of the second is driven from the Z terminal of the first AD844. The supply voltages were taken as V_{DD} = 10V and $-V_{SS}$ = -10V.

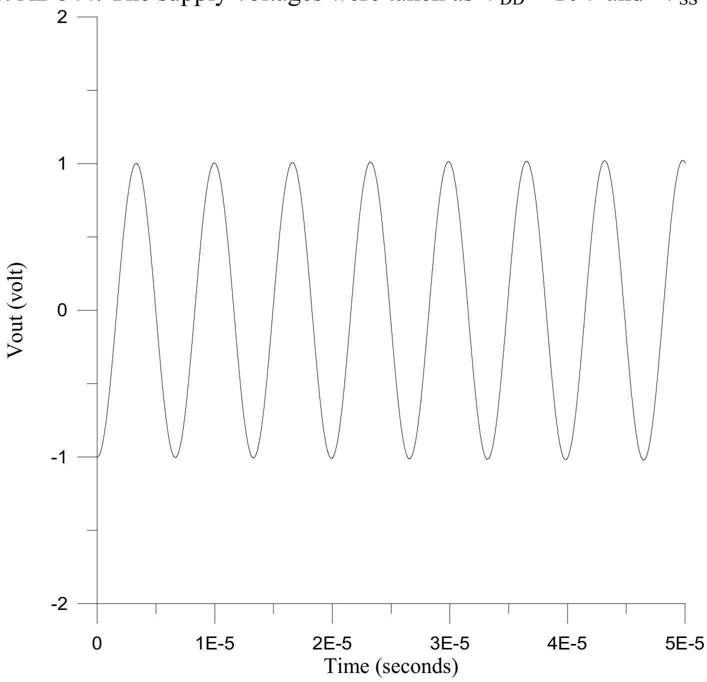

Figure 2: PSPICE simulation result of proposed circuit (R_d=R_b=1KΩ , C_1=C_2=1nF, f=143KHz)

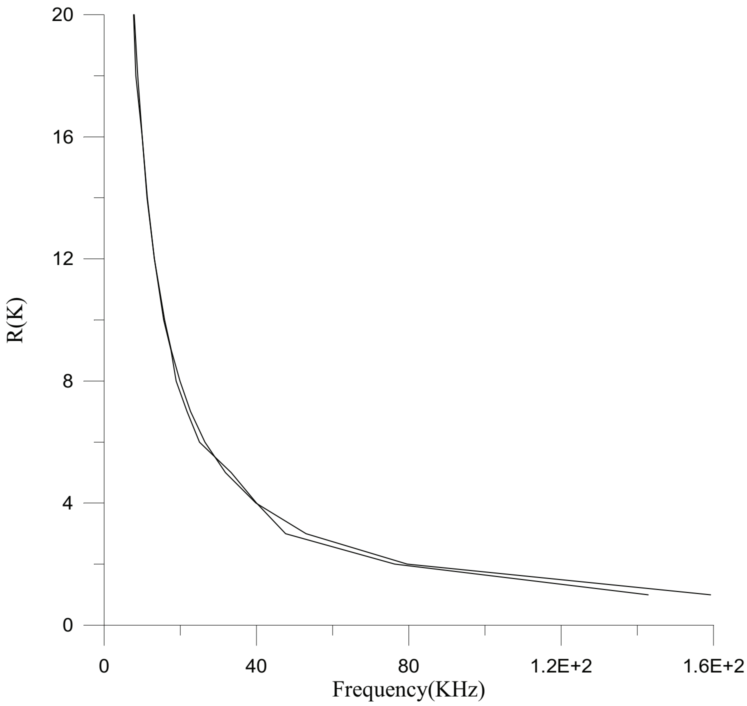

Figure 3: Variation of the oscillation frequency with the R_d=R_b=R

simulation

theory

The tunability of oscillation frequency trough R_b and R_d without influencing oscillation condition is shown in Fig.3.

Conclusion: A new sinusoidal oscillator constructed with three CCIIs , two grounded capacitors and four grounded resistors is proposed. Theoretical results are confirmed by PSPICE simulation. The most important advantage of the proposed topology is the possibility of entirely independent control of oscillation condition and oscillation frequency. Moreover the oscillator is suitable for both monolithic IC and thin film fabrication due to including only grounded passive elements; as a result of this, it can be easily converted to voltage-controlled oscillator (VCO) using JFETs, MOS resistors or OTAs as variable resistors instead of resistors R_b and R_d. The circuit shows low passive and active sensitivities, contains only CCIIs as active elements and exhibits a large tuning range since double-resistance controlled oscillation frequency is possible. For proper design current and voltage tracking errors can be eliminated easily.