A Novel Design and Illustration of Bilateral Active Filters using CCCII for Multi-purpose Low Power Low Voltage Applications

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Abstract*- In this study, we have presented novel circuits presenting the characteristics of current mode bilateral filters. The illustration of the bilateral filters was ascertained by standard Laplace responses of the basic filter responses viz low pass, high pass, band pass and band pass filters. Current controlled conveyor second generation device was used as an active element to implement the circuits The proposed circuits were theoretically analyzed by nodal analysis and the final simulation results were matched with the standard Laplace spice results, which were generated using the standard characteristic equations of basic the filters. The simulation process was carried out on Hspice tool using 45nm PTM cmos technology.*

Keywords*-* Bilateral Filter, CCCII+, PTM, Current mode filters

I. INTRODUCTION

In the field of analog electronics too, there has been always a search for the advancement and merging of the analog devices for multipurpose low power and low voltage applications. An electronic Filter is a very common device used in various electronic applications. The main work of a filter is to shape the frequency spectrum of an electronic signal. With the advancement in technology, the need for low power and low voltage devices forced the designers to fabricate such devices that bear such characteristics and also meet the domestic as well as industrial demand. One such device namely current conveyor invented by Sedra and smith reach the possible heights despite the replaced device op-amp is quite compatible and multi applicable. In this work, we have casted a novel design of current mode bilateral filters, that have the ability to process through either side of the device. The proposed circuits have been well analyzed theoretically through nodal analysis. To identify the linearity of the behavior of these circuits, Laplace transformation of the basic filter was simulated using spice tool. The final simulation responses of the bilateral analog filters were found quite impressive and the characteristics were found matching the standard Laplace responses. A single bilateral filter alone showed the characteristics of inverse filter and buffer logic, thereby proving the bilateral filter. Various analog filtering, communication, instrumentation and Image processing areas are expected to benefit by these novel bilateral filters.

II. LITERATURE REVIEW

In literature, a vast variety of CCII/CCCII based circuit applications are available. Different aspects have been looked into and are tried in design. However, the concept of bilateral filters and respective circuits does not appear as such.

III. CCCII CHARACTERISTICS AND CONSIDERATION

Current controlled conveyor second generation has been used as an active element in the design of bilateral active filters. CCCII has some outstanding features and characteristics, which makes it suitable as well as compatible for low power low voltage applications. The intrinsic resistance of the node X can be self-adjusted in this type if current conveyor. Further, the designer need not necessarily to involve parasitic resistance as passive element in the designs. The novel designs or circuits can be made resistor less. The block diagram of the CCCII is shown in figure 1.1 and its respective conventions have been texted fore after in this paper.

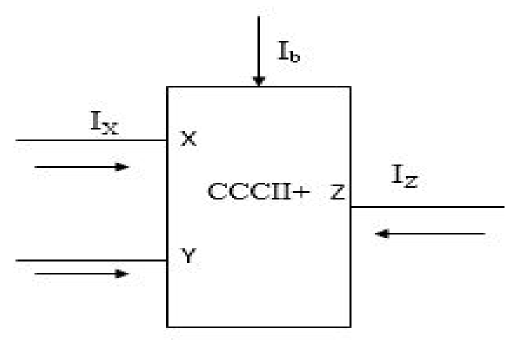

Figure 1.1 Block Diagram of CCCII+

Conventions: $I_Y = 0$; $V_x = V_Y I_Z = + I_x$

Further, the translinear circuit adopted in this configuration is shown in figure 1.2

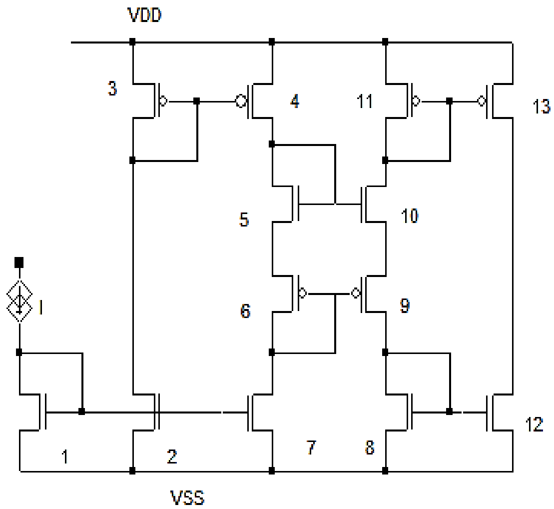

Figure 1.1 Translinear Circuit of CCCII+

IV. INVERSE AND BUFFER CHARACTERISTICS

An inverse filter has the ability to inverse the output response in feedback at its respective input end. The output and input of the buffer filter is same at either of the device. The scheme of the inverse and buffer can be well understood from the figure1.1 and 1.2.

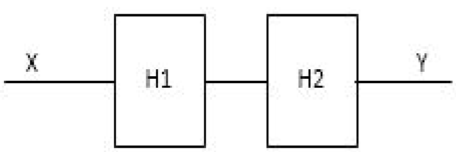

Figure: 1.2 Inverse Filter Block Diagram

The inverse filter scheme for the above block diagram is viz; If H1 and H2 are identical. Which implies H1=H2=I, same order (identity matrix), therefore in that case only, these two functions are inverse of each other.

Further, a buffer logic was adopted in this work. The block diagram of Buffer is shown in figure 1.2

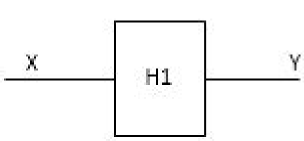

Figure 1.3 Buffer response Block Diagram.

For the above transfer function, if X =Y, then only this transfer function will behave as buffer.

V. PROPOSED METHODOLOGY

The methodology that we have adopted in these circuits is that, we have illustrated the behavior of these circuits through inverse and buffer behavior. The scheme adopted in the bilateral filters is quite clear from the following figures.1.1 and 1.2

Direct filter Analysis*:* Behavioral response of a signal from input to output.

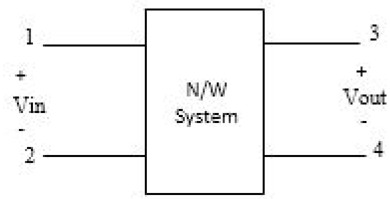

Figure 1.4 Direct bilateral filter response

Inverse filter Analysis: Behavioral response of a signal from input to output.

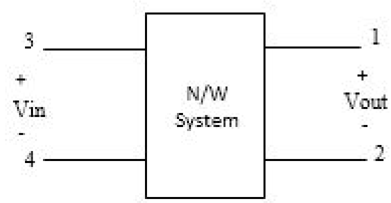

Figure 1.4 Inverse bilateral filter response

VI. FUNDAMENTAL CONSIDERATIONS

The analysis made for the proposed circuit was done on certain number of circuits. The theoretical results from the analysis and was found quite linear and applicable impressive. The analysis of the Proposed circuit blocks shown in figures 1.1 and 1.2 is below:
H(s) = N(s) / D(s)

Where ; H(s)--- Transfer Function
N(s)--- Numerator Function
D(s)--- Denomerator Function

Direct Filter Analysis:

$$\frac{V_2}{V_1} = \frac{(N_2)}{(D_S)}$$

$$\frac{V_1}{V_2} = \frac{(N_1)}{(D_S)}$$

Inverse Filter Analysis:

$$\frac{V_2}{V_1} = \frac{(N_1)}{(D_S)}$$

$$\frac{V_1}{V_2} = \frac{(D_s)}{(N_1)}$$

VII. CONCLUSION

In this work, we have proposed a novel approach to design new class of filters namely bilateral filters. Theoretical analysis of the filters are quite matching the simulation responses. The final results of these filters are under study and in progress.

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