CHAPTER -7

CONCLUSIONS
In this concluding chapter, the main results of the thesis have been summarized and critically reviewed. Chapter 1 highlights the advantages of current mode signal processing and the use of current conveyor based filters in the field of analog filter design. The characteristics of various types of current conveyors, effect of nonidealities on the circuit model, and implementation of CCII and CCCII have been reviewed in Chapter 2. A transformation method is then discussed which can be used to generate current conveyor based structures from well known op amp based structures. The concept of sensitivity is discussed that provides an important criteria for comparing different circuit configurations and for establishing their practical utility in meeting the desired requirements. The research contribution of this thesis has been presented in Chapter 3 to Chapter 6, wherein a number of single-input single-output, single-input multiple-output, multiple-input single-output, multiple-input multiple-output analog filters using current conveyors (CCIIIs and CCCIIIs) have been studied and designed.

In Chapter 3, various single-input single-output (SISO) filter structures namely, generalized multiple loop feedback current mode biquadratic filter, voltage mode all pass filters, channel select filter structure and Tow Thomas biquad based on CCIIIs/CCCIIIs have been designed. The performance analysis of the filter has been carried out. Most of the structures presented in this chapter are either based on CCCII or are extendable from CCII to CCCII and thus facilitate the electronic tunability of filter parameters. The current mode filter, channel select filter and Tow Thomas filter configurations have independent electronic control of $\omega_0$ without disturbing $\omega_0/Q_0$ and also provide electronic and orthogonal control of $\omega_0$ and $Q_0$. Most of the structures use only grounded capacitors
that make the structures less sensitive to parasitics and easy to integrate. The proposed configurations have low active and passive sensitivities. The behavior of practical circuit deviates from the ideal one due to nonidealities (such as parasitics, non unity current and voltage transfers) in the terminal characteristics of the current conveyor. All the proposed structures have been examined for nonidealities. The detailed analysis of current mode and Tow Thomas voltage mode filter has been carried out and a design criterion is also derived for these filters. The feasibility of all the designed filter structures is verified through PSPICE simulations. The all pass filter structure is verified through experiments using IC AD844 and simulations.

As an improvement over the aforementioned approach, single-input multiple-output (SIMO) filter configurations have been developed in Chapter 4. These structures are more versatile than SISO structures discussed in Chapter 3. A current mode SITO filter and a voltage mode structure based on Tow Thomas approach has been suggested. These new structures use grounded capacitors so that the effects of parasitics can be eliminated by pre-distorting the values of external capacitors and also sensitivity of the circuit to parasitics gets reduced. The current mode filter presents low input impedance and high output impedance making it more suitable for designing higher order filter by cascading similar structures. It has been shown that the proposed configurations enjoy electronic and orthogonal adjustment of filter parameters. The performance of these structures has been evaluated using PSPICE simulations.

In Chapter 5, multiple-input single-output (MISO) current mode (CM), voltage mode (VM) and mixed mode universal filters based on CCIIs have been presented. It is
observed that these circuits use CCII and a resistance at x port which can be replaced by CCCII and thus electronic tunability of various filter parameters can be achieved. The circuits have low sensitivity performance, use simple matching constraints and possess orthogonal control of $\omega_0$, $Q_0$, and $\omega_0/Q_0$ for most of the filters discussed. The use of only grounded capacitors in MISO current mode and mixed mode circuits makes these structures less sensitive to parasitics and easy to integrate. The proposed MISO current mode filter provides output current at high impedance whereas output voltage is available at low impedance port in voltage mode configuration. Thus, these structures can be cascaded to realize higher order filters. The use of all plus type of current conveyors and all non inverting voltage signals in the proposed MISO voltage mode filter simplifies the circuit configuration. The proposed circuits use less or comparable number of components compared to the MISO filters reported earlier in the literature.

In yet another approach in Chapter 6, multiple-input multiple-output (MIMO) current mode, voltage mode and two mixed mode filter realizations based on dual/multiple output CCII/CCCII have been designed. These circuits are based/extendable to CCCII and thus allow electronic adjustment of filter parameters. The circuits impose either no or very simple matching condition for obtaining some of the responses, enjoy low sensitivity performance and orthogonal control of filter parameters. The current mode and voltage mode MIMO filters use all the grounded passive components, which is beneficial from integrated circuit implementation point of view and also facilitates accommodation of parasitics. The proposed current mode and voltage mode filter circuits are suitable for cascading as these provide output current and voltage at high and low
impedance ports respectively. One of the mixed mode circuits has been analyzed in detail to study the effects of nonidealities and a design criterion is also developed. All the proposed structures are verified using PSPICE simulations.