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Student Name: Shailendra Bisariya

Supervisor Name: Prof. (Dr.) Neelofer Afzal

Name of Department: Department of Electronics & Communication Engineering, Faculty of Engineering & Technology, Jamia Millia Islamia, New Delhi

Name of Topic: Reconfigurable Analog Modules Using CDTA

KEYWORDS: Current differential trans-conductance amplifier (CDTA), Bulk-driven, Re-configurability, Frequency selective filter (FSF), Current conveyor trans-conductance amplifier (CCTA).

[Findings of the Thesis]

In this thesis, different energy-efficient and high-performance current mode CDTA and CCTA circuits have been developed. These realizations are further used to create CDTA and CCTA-based analog signal processing circuits such as full wave rectifiers, bi-quad KHN filters, reconfigurable frequency selective filters, fractional oscillators, sinusoidal oscillators, monostable multivibrators, etc. The implemented CDTA and CCTA structures utilize multiple performance enhancement techniques such as bulk-driven gain boosting technique, current splitting based trans-conductance boosting technique, circuit optimization using fuzzy logic and NSGA-II algorithm, etc.

- A detailed review of all existing CDTA and CCTA blocks and their based circuits is done which analyzes the essential parameters and provides the state of the art of the existing circuits and their applications.
- A gm-boosted bulk-driven CDTA has been realized that achieves high trans-conductance using a split transistor network. Further, a full wave rectifier circuit employing the proposed trans-conductance boosted BDCDTA is implemented. The simulation results for the BDCDTA-based full wave rectifier circuit indicate a considerable improvement in the output current value and justify its viability.
- Enhanced bandwidth and trans-conductance boosted BDCDTA are realized. The simulation results of the proposed BDCDTA design show a considerable improvement in trans-conductance and in gain bandwidth product. The power dissipation is comparably lower than the existing BDCDTA circuit, even after increasing the number of transistors in the split network.

- Reconfigurable frequency selective filter structures using the proposed BDCDTA are realized. The suggested designs of frequency selective filters show the flexibility to change the frequency range as per the requirement of the communication system and control filter gain as per the requirement. These newly designed frequency-selective filter structures are suitable for bio-medical signal processing and medium-wave communication applications.
- The current mode fractional-order sinusoidal oscillator using two CDTA and two fractional capacitors is realized. The electronic tuning of the frequency is done by varying the gm value of the CDTA, and its stability analysis is also done.
- A novel sinusoidal oscillator is realized using a single CCCCTA device in the current mode. This circuit has fewer elements for implementing the sinusoidal oscillator with all the passive components grounded. The frequency can be easily varied by changing the value of the biasing current. Simulation results further confirm that this design can be used for a wide frequency range starting from a few Hz to MHz, and the sinusoidal signal can be generated.
- A low power and high trans-conductance gain CDTA based on the fuzzy-TOPSIS and NSGA-II optimization algorithm that optimizes the transistor aspect ratio and the biasing current of the CDTA circuit to achieve simultaneous minimization of power consumption and the maximization of trans-conductance gain is developed. Results obtained show that the optimized CDTA offers a 12.5 % improvement in the trans-conductance gain and a 38.93 % reduction in the power consumption compared to the existing CDTA design, a figure of merit.