Notification No.: 514/2022

Date of Award: 02-06-2022

Name: RAVENDRA SINGH

Name of the Supervisor: Prof. Dinesh Prasad

Department: Electronics & Communication Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi-110025, India

Title of the Thesis: FTFNTA based Analog Signal Processing/Generation Circuits

Abstract

In this we discuss the Four Terminal Floating Nullor Transconductance Amplifier (FTFNTA) and its applications. The versatility and flexibility of the FTFNTA are demonstrated and exemplified. Its wide range of applications in the field of signal processing and generation circuits is investigated.

The thesis has been divided into five chapters. A brief summary of the research work carried out in this thesis is as:

Chapter-1 (INTRODUCTION), Firstly we present an overview of various active building blocks that are already available in the literature and have been substantially exploited in the domain of analog signal processing. Few of them are OP-AMP, CC, OTA, CDTA, CFOA, VDTA, CDU, CITA, CDCC, CCCTA, VDVTA, CIDITA, CDBA, VDBA, OTRA, CDDITA, and FTFN. Later in this chapter, FTFN is discussed in-depth, as is the origin of FTFNTA. In this process, different FTFN realization methods are discussed with their merits and demerits. The Nullor realization of FTFNT is presented. The full integration of the entire circuit of the FTFN leads to the realization of monolithic FTFN. But the most popular form of realization of FTFN is achieved by the operational floating amplifier. This technique extends the performance of the available OpAmps from voltage mode to current mode by providing an additional current-output terminal. Another realization of FTFN is achieved by Nullor model of second generation Current Conveyor. Apart from these realizations, several transistor based FTFN circuits were also present in the literature. In this chapter folded cascode realization, balanced realization, realization using translinear cells, high transconductance CMOS realization, and multi-terminal FTFN realization is explored. Later on, a detailed functioning of FTFNTA is also investigated. The basic concept of FTFNTA and its detailed working is explained. The CMOS structure of FTFNTA is illustrated with the aspect ratio of each transistor and other design parameters. The characteristics of

FTFNTA are verified through various AC and DC analyses. Pspice simulation results confirm the characteristic of FTFNTA. Non-ideal schematic of FTFNTA is also demonstrated. So in this chapter, a background of the development of FTFN and its utilization in the construction of FTFNTA is demonstrated. The performance of the designed FTFNTA is also verified through Pspice simulations. This FTFNTA circuit will be utilized to develop various signal processing/ generation circuits.

Chapter-2 (GROUNDED/FLOATING IMMITTANCE SIMULATORS), In this chapter, different immittances are realized i.e. floating lossless inductor, grounded lossy inductor, grounded and floating capacitance simulator, grounded and floating FDNR. Also, different applications are developed using these immittances to verify the feasibility of these designs. The comparison of the proposed designs with existing designs shows that the developed circuits are utilizing less passive components and mostly all these components are grounded. Hence these designs are suitable for integrated circuit realization. Also, these designs are having the property of electronic tunning. So, developed circuits are showing better and improved performance.

Chapter-3 (REALIZATION OF FILTER/INVERSE FILTER TOPOLOGIES), In this chapter, we investigate a hybrid projective combination-combination synchronization (HPCCS) scheme among four non-identical hyperchaotic (HC) systems via adaptive control method (ACM). Based on Lyapunov stability theory (LST), the considered approach identifies the unknown parameters and determines the asymptotic stability globally. The proposed scheme is applicable in secure communication and information processing. Finally, numerical simulations are performed to demonstrate the effectivity and accuracy of the considered synchronization as well as control techniques by using MATLAB.

Chapter-4 (IMPLEMENTATION OF OSCILLATOR), the signal generation circuit i.e. oscillator is designed. It is a single resistance controlled oscillator. In this, the frequency of oscillation and condition of oscillation are independently adjustable through a resistor. This circuit comprises one FTFNTA block and only grounded passive components. The use of grounded passive components makes the oscillator circuit a suitable choice for IC fabrication. The impact of non-ideality on the frequency of oscillation and condition of oscillation is investigated in detail. The sensitivity analysis is also performed. The Monte Carlo analysis is also performed to observe the effectiveness of this circuit.

Chapter-5 (CONCLUSION AND FUTURE WORK), In this chapter, an overview of the entire work and conclusion along with future scope for further research work is illustrated. A theoretical analysis is also carried-out to observe the impact of temperature variation on the performance of the proposed designs. To investigate this, firstly we would like to discuss the impact of temperature variation in MOS parameters (i.e. mobility of charge carriers (μ) and threshold voltage (V_t)) because the performance of the proposed designs is dependent on these MOS parameters. The temperature volatility of threshold voltage (V_t) and mobility (μ) of charge carriers influenced the performance and robustness of the ICs. Such volatilities are arises due to fluctuation in surrounding temperature and/or due to heat generated in MOS transistors by power dissipation. So, the operating temperature of an IC does not remain constant and hence affects its functionality.