CHAPTER-IX

CONCLUSION

9.1 INTRODUCTION

The investigation was intended to realize certain active RC network for application in Instrumentation, Communication and Industrial Control Systems.

9.2 BRIEF OUTLINE OF THE WORK

In Process Instrumentation and Control, signal frequency makes excursion down to very low/small values such that filtering shaping and computation network can hardly use real inductors, whenever necessary. Replacement of real inductors with active RC simulated inductors started as early as sixties but newer schemes of simulation are still being added to the bulk of literatures already existing, on various counts of superiority. After a little relevant review of the state of the art, the present treatise opens with some new schemes[1,2] of such simulation of both grounded and floating inductors with RC parameters and standard Operational Amplifiers (OA). Most of these techniques have been aptly supported with application examples or suggestions thereof. The first one[1] of the series uses two capacitors and two OA's. The scheme however is versatile enough to produce linear, bilinear and ideal inductors by minor trimming. But the realized inductor is of grounded type. A sinewave generator has also been developed from this scheme. To have low component and high selectivity, analogue filters often require a floating lossless inductor. The second scheme[2] provides this simulation through an altogether different but logical approach. A practical filter realization scheme has been appended to show the application of such a simulated inductor.

While the conventional filter can be synthesized using resistors, capacitors and simulated inductors, inductorless filters can also be obtained through a different synthetic approach using less components, particularly the active ones. The investigation towards such synthesis has been made[3] with emphasis on all-pass filters where the filter gain with frequency remains constant but the delay follows a specific law. The method has then been extended to other types of filters such as high-pass, band-pass, low-pass and band-rejection. The method uses a single OA and the approach is very general.

A very major function active RC networks are called upon to perform is to generate waveforms. Basically these systems are regenerative autonomous systems. From equipment testing to data telemetering, a variety of purpose is served by such systems. Investigations have been made to develop a number of such regenerative systems. Sinewave generation is a major area that has been receiving attention since long. However generation of very low frequency sinewave through a direct approach without using large RC parameters is of consequence in Process Instrumentation and Control Systems and is of late being investigated with considerable emphasis on practical footing. Investigation on generation of sinewave using feedback in active RC filters have first been made[4]. A difference term co-efficient in the expression for frequency, either in the numerator or denominator makes generation of very low or very high frequency oscillations possible in such systems. All the proposed schemes are single resistive element tunable. For application in telemetering of process data the system has been converted to VCO's as well.

Operational amplifiers have been used in the investigations mentioned so far. The basic differential input stage of OA can itself form a kind of active block with certain special properties retaining the essential characteristics of the OA. This block can be called the Emitter Coupled Differential (Transistor) Pair (ECDP). Very stable sinewave has been generated[5] using this block. Such a system has been shown to be almost insensitive to temperature and supply variation. Such a block has other uses also. Following the van der Pol oscillator, waveforms starting from quasisinusoidal to hard relaxation mode have been generated in the proposed system[6]. Further the discrepancy in the earlier analysis to establish the point-to-point corroboration of the derived waveform has been explained by assuming a hyperbolic tangent type transfer characteristic of the differential pair. The system has been further extended to obtain a VCO by controlling the differential bias which effectively controls the slope of the transfer characteristic[7]. Finally the same scheme has been shown to obtain pulse train whose repetition rate is linearly related to a single resistive element[8]. This linear pulse generator is also shown to be almost insensitive to temperature and supply variation and an approximate analysis corroborates the results remarkably well.

9.3 FINAL COMMENTS

The investigations carried out here provide a systematic approach to develop additional superior schemes of active RC circuits. Although this is not the only approach, it may be considered powerful in the sense that the proposed schemes use either Operational Amplifier as the active block or a part of the operational amplifier in its place making the schemes more simple and economic. A few of the circuits that have been developed are for low frequency applications,that are more relevant to Process Instrumentation and Control. In the realizations it has been attempted to use an unified active block, to derive low sensitivity and high performation as well as low count passive components with small spread in values, to make the system IC-compatible, to obtain independent single element controllability of the relevant response function and to extend the range in time or frequency in an efficient manner.

To a large extent these have been achieved in the investigations. These results in turn show some positive features and marked improvement in the design and synthesis of active RC circuits for applications in Instrumentation, Communication and Industrial Control. It is expected that these would be accepted without reservations.

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