ABSTRACT

Analog signal processing has been receiving considerable research interest over the last few decades. Typical tools include the design of continuous time electronic filters, sinusoidal oscillators and rectifiers. These basic modules find numerous applications in modern day communication and instrumentation systems. Processing signals in analog form cannot be avoided as the real world is analog even when most of the computation carried out in present day systems is digital in nature; thereby necessitating the need for exploration of better analog signal processing circuits. This forms the motivation for the present thesis.

In the early days of the development of analog signal processing modules, specially filters, passive devices were mostly used. Gradually active devices like operational amplifiers were added thereby initiating the era of active-RC, active-R and active-C circuits. However, the frequency limitation associated with operational amplifiers soon led to the need of alternatives that could provide better performance characteristics. Some of these alternatives are operational transconductance amplifiers (OTAs) and various current conveyors. The latter, since its introduction by Sedra/Smith in 1968, has attracted significant research attention due to several advantages such as high-input impedance and better frequency performance. Therefore, the current conveyors (and its variants) have been chosen within this thesis as the active building blocks for providing better analog signal processing modules.

The applications considered are voltage/current/transresistance/transadmittance mode single-ended and fully-differential analog filters and quadrature and multiphase sinusoidal oscillators. Precision rectifiers based on bi-phase amplifier are also discussed. Digital control of circuit parameters like pole-\(\omega_0\), pole-Q and bandwidth is obtained by incorporating digital control facilities within existing analog building blocks (CCCII) to realize digital current controlled differential voltage conveyor (DCCDVC).

The proposed modules are analyzed and simulated extensively for their behavioural characteristics with promising results. Furthermore, the experimental results prove the devices to be feasible and compatible with IC fabrication and can be expected to find use in a number of practical applications. This thesis, by providing new solutions for basic analog modules, attempts to make a novel addition to the knowledge base on the subject.