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4. **Name of Topic:** Design and Simulation of Carbon Nanotube Based Signal Processing Circuits
5. **Keywords:** CNT, CNTFET, Current Conveyor, Active Inductors, Waveform Generator

Findings

Silicon based devices, particularly silicon based bulk MOS technology has been serving us since multiple decades now because of their huge advantages. Silicon is Nature's one of the biggest gift and can be easily extracted from sand. Further, silicon MOSFET was efficiently scaled to extract more and more performance and enhance the transistor count in ICs to keep Moore's law valid till the recent past. However, now there is a problem, scaling MOSFET further and further below 18/15 nm is challenging. The SCEs increase significantly thus making device uncontrolled, in off state leakage, gate tunneling, reliability issues, self-heating issues, excessive process variations, random doping fluctuation etc. New and novel device structures like double gate (DG) MOSFETs, FinFETs, Trigate MOSFET (T-MOSFET), silicon nanowire devices, gate around devices, SiGe devices, strained silicon devices, metallic source/drain devices, partial ground plane devices (PGP-MOSFET), tunnel field effect transistors (TFET) high-K material devices, gate engineered devices have been developed.

A recent watershed moment in material engineering is the discovery of a unique material carbon nanotube (CNT). CNTs have reduced scattering and nearly ballistic transport of charge carriers. An important characteristics of CNTs is their dual properties, as they can be metallic as well as semiconducting. An important application of CNTs which can revolutionize the electronics world is a CNT based field effect transistor (CNTFET).

Keeping in mind the above mentioned advantages of CNTs and CNTFET, we have got enough motivation to work on the design and applications of CNTFETs in analog signal processing. The use of CNTS will result in highly dense, energy, power and thermally efficient analog circuits. Since CNTFETs have been used extensively in digital domain, CNT based analog sector is still comparatively unexplored. In this thesis, we designed and simulated various versions of current conveyors, CCII+, CCII-, Dual Output Current Conveyor, Operational Transconductance Amplifier and developed their applications as waveform generator, active grounded inductor, oscillators, also. An extensively study of these circuits has been made and the comparative analysis have been made with the conventional CMOS based circuitry. The finding is that the CNT is indeed a wonderful material and CNTFET is a promising device, as all the CNTFET based proposed circuits have significantly outperformed the conventional MOS based circuitry. An important observation from all the designed and proposed circuits is that the CNT parameters, like number of CNTs (N), inter-CNT pitch (S) and CNT diameter (D_{CNT}), plays an important part in performance enhancement of these circuits. Optimizing these parameters result in significant improvement in various performance measuring parameters of the proposed circuitry. The various parameters like area, power, speed, gain, 3-dB bandwidth, total harmonic distortion (THD) and thermal stability etc. all get improved by optimizing N, S and D_{CNT}.