ABSTRACT

The demand for monolithic mixed signal Integrated circuits(IC) has been dramatically increasing in the recent years. Evolution of IC technology and advances in the fields like communication systems and consumer electronics, have fueled this growth. Systems are becoming more complex with functionalities like Radio Frequency (RF), analog, power distribution and digital being integrated on the same chip. The challenge is not only designing such systems but also testing each of these high performance blocks. There is a need for novel, flexible circuits that can take on multiple roles.

The Phase shift Oscillator/ Ring oscillator is a simple, powerful circuit used in many applications like CMOS process characterization, RF frequency synthesis, delay generation, etc. In this dissertation, the primary focus is on harmonic distortion control in Phase Shift Oscillators. A new technique is described using which the PSO can be used to generate multi-phase, square waves, low distortion sine waves or perform frequency multiplication or division for frequency synthesis. The method involves weighting each output of the PSO's output and summing. A bread board prototype of a low distortion sine generator has been implemented using the proposed technique. The sine wave generator can generate -100dB Total Harmonic Distortion (THD) sine waves using extremely low cost discrete components. Simulations of on-chip sine wave generators implemented in a 0.13um CMOS technology process demonstrate using the proposed technique to generate -80dB THD sinusoids at large signal swings.

The second part of the dissertation focuses on testing of Integral non-linearity (INL) of Analog-to-Digital Converters (ADC). The proposed algorithms reduce test cost associated with expensive hardware, and test cost associated with test time. Low cost voltage-shift generators that can enable testing of High resolution ADCs are investigated. It is shown that with the proposed shift generator, INL of ADCs with resolution as high as 16-bit can be characterized. The last part of the dissertation focuses on sensor interface circuits for soft elastomeric capacitors for Structural Health Monitoring (SHM) applications.