ABSTRACT

Stable frequency references serve many vital purposes, such as timekeeping for calendar functions and reference clock for radios and micro-controllers. While quartz crystal-based references can achieve the desired performance, they are bulky, expensive, and suffer from long start-up time. Hence, techniques for implementing fully integrated frequency references that are energy efficient and can achieve excellent frequency stability across a wide temperature/voltage range are needed. In this talk, I will present methods for improving the frequency accuracy of RC oscillators using precise cancellation of the resistor TC across PVT. I will show robust compensation can be achieved using a parallel combination of switched-resistors that are digitally controlled by pulse-density modulated sequences. Finally, I will present experimental results obtained from prototype oscillators fabricated in a 65nm CMOS process and use them to illustrate that reducing the inaccuracy to better than 150ppm (2.1ppm/°C) is feasible without compromising long-term stability (2.5ppm Allan deviation) and power efficiency (1μW/MHz).