Analog circuits and digital circuits have, for the most of history, been fabricated on separate substrates in electronic systems. However, the drive for higher performance, lower cost, and lower power have pushed for the integration of these two parts onto a single microchip. While plausible and feasible, the marriage of the two is not without problems and difficulties. One of the most insidious problems is the substrate noise coupling from the highly noise tolerant digital circuits to the extremely noise sensitive analog circuits. Digital noise can severely degrade crucial analog performance if not contained properly.

Up to now, most efforts of minimizing digital noise effects on analog circuitry have been to utilize good layout techniques and fully-differential analog signal paths along with computer-aided-design verification. Although this process ensures the mixed-signal system performs as desired, no real effort has been made to design circuits that pointedly address the substrate noise problem.

Therefore, the focus of this research is to characterize and investigate digital noise mitigating circuit techniques, in the digital and analog domains. The benefit of easily integrating analog and digital circuits would be immense and epochal.

In our approach, we propose to shape the digital noise out of the band of sensitive analog circuits. This is possible by monitoring and manipulating digital transitions or capacitively coupling anti-noise signal to the substrate in order to cancel noise in the band of interest. We are exploring both possibilities using a digital noise shaping technique similar to delta-sigma modulation.