Low Power RF Front-End for Wireless Microsensor Systems

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The design of wireless microsensor systems has gained increasing importance for a variety of civil and military applications. With the objective of providing shortrange connectivity with significant fault tolerance, these systems find usage in such diverse areas as environmental monitoring, industrial process automation, and field surveillance.

The main design objective is maximizing the battery life of the sensor nodes while ensuring reliable operations. For many applications, the sensors need to "live" for 1-5 years without battery replacement. To achieve this goal, the microsensor system has to be designed in a highly integrated fashion and optimized across all levels of system abstraction. This also means that all the characteristics particular to the microsensor system must be exploited. One such characteristic is that the RF output power is small due to the short transmission distance, which makes the transmitter electronics the dominant source of energy dissipation.

In this research, the impact of circuit non-idealities including noise, nonlinearity, and modulation errors upon system performance are analyzed, and these effects are incorporated into the design of key front-end components. In addition, the effect of increasing the RF transmit power, which is small, to compensate for the SNR loss due to circuit non-idealities is investigated. This can potentially lower the performance specification of the RF front-end circuits and reduce the over-all power consumption.