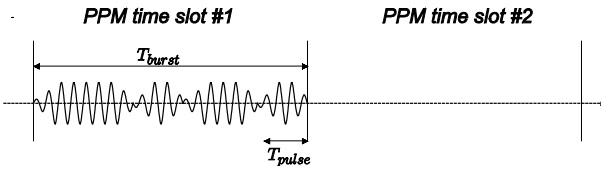
Pulsed UWB Transceiver for Small Lightweight Flying Vehicles

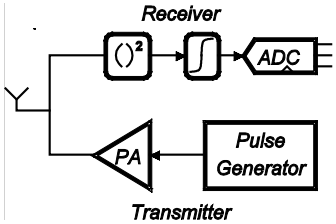
D.C. Daly, M. Bhardwaj, P. Mercier, A.P. Chandrakasan
Sponsorship: DARPA, NSERC

Ultra-wideband (UWB) technology has recently gained popularity for low-power, low-data rate wireless links [1-2]. In January 2007, an amendment to the low-power IEEE 802.15.4 standard was approved that adds support for an alternate, UWB physical layer. The UWB physical layer supports scalable data rates from kbps to Mbps, distances up to 100m, and both non-coherent and coherent signaling. The signaling scheme includes pulse-position modulation (PPM) combined with BPSK pulse bursting. Figure 1 presents a time-domain waveform of the 802.15.4a signaling scheme, in which multiple pulses are BPSK- modulated in a short burst during a single PPM time slot.

Our target wireless application is a small, lightweight flying vehicle. The flying vehicle must be able to communicate wirelessly up to 100 meters at a data rate of tens to hundreds of kbps. As the vehicle is miniature, power consumption, volume, and weight must all be minimized. In such systems, the transceiver must be highly integrated with few if any off-chip components. Non-coherent UWB signaling is used to relax the frequency accuracy requirements of RF circuit blocks, thereby allowing for a highly integrated, low-power implementation. Figure 2 presents the proposed UWB transceiver architecture. The receiver consists of a windowed energy detector and the transmitter consists of an all-digital pulse generator followed by a power amplifier. The lack of phase information associated with non-coherent signaling makes synchronization more challenging, leading to longer preambles. We are designing codes and algorithms to minimize this penalty.



▲ Figure 1: Time-domain representation of UWB pulse bursting combined with pulse-position modulation.



▲ Figure 2: Proposed 802.15.4a transceiver consisting of a burst-mode UWB transmitter and a non-coherent, energy-detection receiver.

REFERENCES

[1] F.S. Lee and A.P. Chandrakasan, "A 2.5nJ/b 0.65V 3-to-5GHz subbanded UWB receiver in 90nm CMOS," in *Proc. IEEE International Solid-State Circuits Conference*, San Francisco, CA, Feb. 2007, pp. 116-117.

[2] D.D. Wentzloff and A.P. Chandrakasan, "A 47pJ/pulse 3.1-to-5GHz all-digital UWB transmitter in 90nm CMOS," in *Proc. IEEE International Solid-State Circuits Conference*, San Francisco, CA, Feb. 2007, pp. 118-119.