A Low-power High-speed Ultra Wideband Pulse Radio System

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***Abstract*—We present a low-power high-speed ultra-wideband (UWB) pulse radio transmission test platform. The transmitter circuit is fabricated on the Peregrine semiconductors 0.5 micron silicon-on-sapphire (SOS) CMOS process and packaged in a DIP16 package. 12.5Mbps data rate of wireless transmission is achieved. The power consumption of the transmitter is 10mW when the pulse rate is 90MHz. The core circuit size is 70μm by 130μm. The transmission distance is in excess of 4m. The circuit is a transformative technology candidate for high-data rate and low power wireless biomedical applications.**

I. Introduction

Recent years have seen increasing demand of wireless communication technology for sensor nodes. Battery-powered systems require wireless transmitters with high data rate transmission and reduced energy consumption. UWB pulse radio has the potential to satisfy these requirements and is widely used in indoor communications, personal communications, wireless sensor networks, body area networks and neural recording systems.

We developed a compact UWB pulse radio transmitter which can be easily adapted as a short-range wireless module [1]. This device is ideally suited to low power wireless biomedical system. We implemented a wireless transmission system in order to characterize the pulse-radio performance.

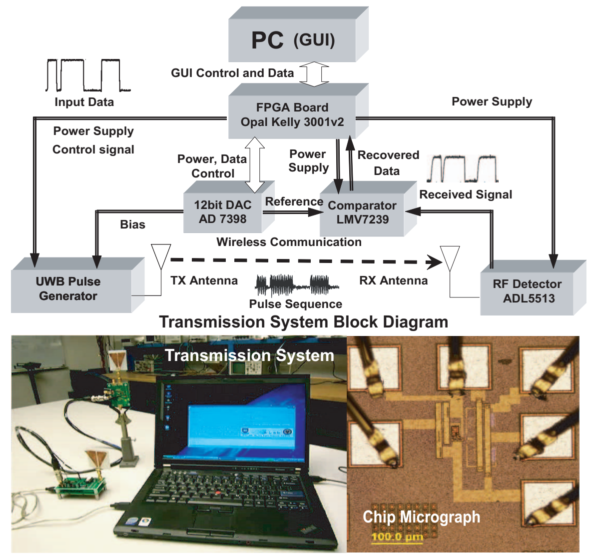

Fig. 1. Ultra Wideband pulse radio wireless transmission test system. The input signal is delivered from PC to the FPGA through a USB bus. UWB transmitter convert the input signal into pulse sequence. The pulses are received by an RF detector, and recovered to digital signal by a comparator. The received data is sent back to the computer through the FPGA.

II. Demonstration description

The UWB pulse-radio transmission system block diagram (with typical waveforms at different nodes) and photographs of the demo setup and transmitter chip is shown in Fig. 1. The equipment will include a laptop, a UWB transmitter board and a receiver board. An oscilloscope (TDS-2014B) may be used to monitor waveforms at different nodes of the system.

In the test system, data is sent from a PC to the pulse-radio transmitter through an OpalKelly 3001v2 FPGA board. The UWB pulse-radio transmitter converts the data into a sequence of pulses and transmits them through the antennas. The pulses are received by an Analog Device ADL5513 Logarithmic RF detector, and recovered to a digital signal by means of a comparator in the receiver. The received data is recorded back to the computer through the FPGA. We use a 12 bit DAC (AD7398) to provide bias voltages for the transmitter and comparator circuits. The system utilizes a graphic user interface to control the biases and transmission data rate. With the GUI one can select, send and receive a file in the computer with the UWB pulse radio system.

III. Demonstration experiencing

With the Graphic User Interface, a visitor may choose a file (either text, image or video) in the computer, then send the file using the UWB pulse radio system and receive it back. Signal waveforms at different nodes of the system are monitored by the oscilloscope. The transmission data rate can be controlled by the visitor. The visitor could also compare the transmitted file and received file. At higher data rate, the bit error rate (BER) will increase. Some error codes or spots will present in the text or image files. BER can be calculated. The visitor can also change the transmission distance or orientation of the antennas to evaluated the transmission system.

IV. Track selection

This demo would be related to ISCAS 2009 track 2.3: Wireless Technology for Medical Applications.

References

[1] W. Tang, A. Andreou, and E. Culurciello, "A low-power silicon-on-sapphire tunable ultra-wideband transmitter," *IEEE International Symposium on Circuits and Systems, ISCAS 2008.*, pp. 1974–1977, May 2008.

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