

UWB Research of VTVT Laboratory at Virginia Tech

Virginia Tech VLSI for



Telecommunications

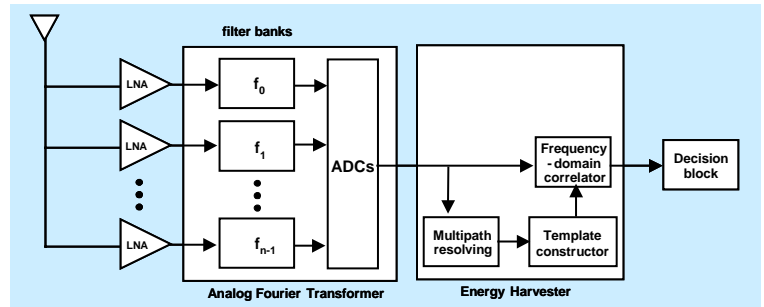
WHAT WE DO

VTVT (Virginia Tech VLSI for Telecommunications) laboratory focuses on development of low-power VLSI systems for wireless communications applications. One of the major research topics of the VTVT laboratory is UWB (Ultra Wideband), which has drawn phenomenal interest from industry as well as academia recently. We are investigating possible means for energy efficient smart UWB systems for communications and radar applications. More specifically, our research focuses on system architectures and low-power CMOS implementations of UWB systems.

Research – VTVT research activities on UWB can be grouped into four broad areas:

• Low-power CMOS UWB Radios

We are developing digital CMOS UWB radios with a high data rate (100 Mbps) and compliant to the upcoming IEEE standard 802.15.3a. The radio architecture is based on our frequency domain approach. The key idea for the proposed method is to extract the frequency components of the received signal and to perform signal processing in the frequency domain. The proposed frequency domain approach relaxes the speed requirement for ADCs and reduces complexity of a rake receiver. In addition, the proposed method allows use of narrowband LNAs.

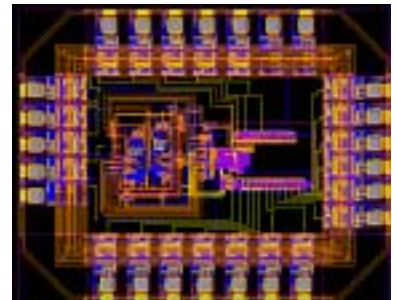


• UWB Radios for RFID

UWB is a promising technology for RFID, which requires low cost, low-power, and small size. Currently, we are developing ultra low-power transmitter chips, which can be planted on plastic cards or badges. Our design approach is to minimize the circuit complexity at the transmitter side, while a high performance receiver compensates any performance degradation at the transmitter side.

• Energy Efficient Wireless Ad Hoc and Sensor Networks

Our research concerns an energy efficient UWB radio interface for sensor nodes, which are small, operate at low data rates, and have extremely limited and finite energy. For sensor networks, it is undesirable to trade-off additional circuit area and processing complexity to achieve more efficient communications in terms of radiated energy per bit. Sensor network applications must consider the costs of signal processing as well as the radio efficiency. Instead of attempting to use diversity schemes that increase signal processing area and power, this project proposes a novel UWB system design that considers energy efficiency in terms of both radiated energy and processing energy.



WHO WE ARE

The Virginia Tech VLSI for Telecommunications (VTVT) laboratory was founded in 1997. Currently, there are 14 graduate students (9 Ph.D. and 5 MS levels) and two visiting scholars.

Current and Recent Sponsors:

Advantest, Electronic and Telecommunications Research Institute (ETRI), Lucent, Master Solutions, NSF, NeoReach, Samsung

Recent Products:

- Programmable CMOS UWB Pulse Generator
- WCDMA RAKE Receiver
- H.263 Video Codec
- ADCs
- Viterbi Decoder
- Turbo Decoder
- SRAM Compiler,
- Low-Power High-Speed Adder/Multiplier

• Accurate UWB Ranging for Asset Location and Wireless Sensor Networks

Two important parameters in delay estimation are signal-to-noise ratio (SNR) and signal bandwidth. Since a UWB signal has a wide bandwidth, it is a good candidate for accurate ranging. Iterative pulse reception through averaging is a promising method, which approaches the theoretical lower bound on range estimation error. We are investigating enhancements to ranging accuracy under various circumstances and environments based on an iterative pulse reception technique.

Education – The laboratory offers research opportunities for students and visiting scholars from other universities and industry. We share knowledge on UWB through presentations and seminars as well as publications.

Outreach – Services include technical education, short courses, and seminars. The industrial affiliates program provides a means for VTVT researchers to rapidly transfer new ideas, inventions, and technologies to industry. This transfer is accomplished through interaction with faculty and students, shared software, and technical reports.

Facilities – VTVT laboratory provides state-of-the-art hardware and software tools for UWB research. Hardware includes workstations, PCs, rapid prototyping platforms, and measurement instruments. Software includes CAD tools provided by Synopsys and Cadence, ADS, and custom ns-2 builds. With these tools, VTVT laboratory follows industry Systems-on-chips (SoC) design flow and fabricates chips through MOSIS.

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