ULTRA-WIDEBAND RADIO for WIRELESS COMMUNICATION

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UWB Radio Measurements in the Cargo Hold of the USS Curtiss

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BRIEF DESCRIPTION OF DEMONSTRATION

Ultra-wideband radio ranging and data transmission demonstration using hardware provided by Time Domain Corporation. (Currently the lab is rebuilding its measurement capabilities to conform to the regulations stated by the FCC.)

DISTINGUISHING CHARACTERISTICS RELATIVE TO STATE-OF-THE-ART

UWB radio is a spread-spectrum system in which the transmitted signal's power is spread over an unusually large bandwidth, generally without the use of a carrier frequency and mixers. Information is encoded in the pulse transmission time or sign relative to a reference, rather than in the amplitude or frequency of the signal (such as AM or FM signals). The resultant signals are sharply defined in time of arrival, allowing accurate time-discrimination and resolution. The result is a system that is especially robust in noisy, multipath environments. The encoding is also particularly useful in secure applications. Other promising applications include imaging through materials.

APPLICATIONS	RECENT HIGHLIGHTS, LEVEL OF DEVELOPMENT, UPCOMING MILESTONES
In Feb. 2002, the FCC approved regulations applicable to this radio technology. There are severe power density limitations that will force applications to be short range, e.g., fully mobile indoor communication and location systems. Anticipated applications also include imaging through materials, everything from land mine detection to construction tools.	Experimental links now can perform at data rates exceeding 1 Mbps. In an effort to increase hardware development activity, USC has teamed with UC Berkeley (circuits) and UMass (antennas) to win a DoD-sponsored grant for the study of low-power short-range UWB systems. The FCC regulations are forcing some retooling of our UltRa Lab equipment. The Paul G. Allen Wireless Test Facility, an anechoic chamber donated to our effort by the co-founder of Microsoft, is operational, and has been used to characterize UWB antennas, transmission through materials (for Magis Networks) and antennas for 802.11a applicatons (Intel). New research is aimed at developing UWB signal generators that compensate for transmission distortions, and achieve efficient received waveforms for ranging and data communication.

BRIEF DESCRIPTION OF UNDERLYING TECHNOLOGIES

- UWB RF circuits – Current VLSI technology is still under development. Further development of UWB, low-noise, high dynamic-range amplifiers, UWB-tunable notch filters, high-bandwidth correlators, and low-voltage pulsers will be useful. Improvement in A/D converter speeds may facilitate new radio circuit architectures and capabilities. Three different approaches to UWB radio architecture are being explored within our research realm.
- UWB antennas – Because these antennas are UWB and not tuned for narrowband applications, they pose design problems for efficient operation, i.e., impedance matching across a wide bandwidth. However, solutions to this kind of problem are known or are on the horizon.
- Wireless system architectures – UWB radios should take advantage of time diversity in their design by using selective Rake reception. One of the major UWB system issues is speed of signal acquisition. Serial and parallel handoffs and properties of the channel may be used to reduce acquisition time.

LIST OF PUBLICATIONS, REFERENCES, URLs

References are available on the UltRa Lab web page URL: http://ultra.usc.edu/ulab/

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