Multipath Channel Dependence and Modeling in UWB Radio

USC | IMSC

A NATIONAL SCIENCE FOUNDATION
ENGINEERING RESEARCH CENTER

Graduate Student: Robert Wilson
Faculty: Prof. Robert A. Scholtz

Research Goal

• Research in support of the design and deployment of ultrawideband wireless systems

• Determine the effect of channel properties on radio performance and determine key properties

• Reduce channel estimation and modeling complexity

•UWB channels can have hundreds of multipath components with intractable statistical descriptions
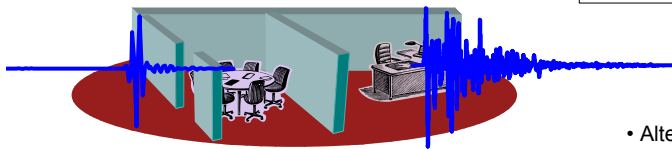
Research Approach

• Compare published models and measured data for effect on system performance

• Look for trends as functions of measurable channel properties

• Recommend simplified models for system analysis

• Use simplified models to aid in radio design and analytical performance calculations

Uniqueness & Related Work

• Analyses of radio link performance assume some channel model *a priori*, often simplified for tractability, regardless of how accurately the model reflects real world behavior

• Channel modelers take the converse approach considering only congruity with empirical observations and neglecting model tractability

• The UltRaLab anechoic chamber and extensive instrumentation enable us to perform high-quality empirical work, our channel measurements are widely used and cited in UWB analysis and we maintain a large internet accessible database of measurements made by ourselves and others

Role in IMSC

• UWB radio can provide high speed wireless communication for home networking, for example:

• wireless audio

• multimedia transmission

• Fine resolution provides utility in ranging, sensing and imaging applications
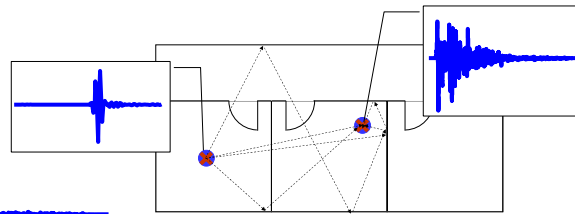
Accomplishments

• Alternative amplitude and time of arrival distributions shown not to have significant effect of performance of some common receivers

•Publications:

•R. D. Wilson and R. A. Scholtz, "Template Estimation in Ultra-Wideband Radio", Asilomar Conference on Signals, Systems and Computers, Nov 2003

• R. D. Wilson and R. A. Scholtz, "Comparison of CDMA and Modulation Schemes for UWB Radio in a Multipath Environment", Globecom, Dec 2003

• R. D. Wilson and R. A. Scholtz, "On the Dependence of UWB Impulse Radio Link Performance on Channel Statistics", ICC, Jun 2004

$$w(t) = \sum_{k=1}^{N} c_k s(t)$$
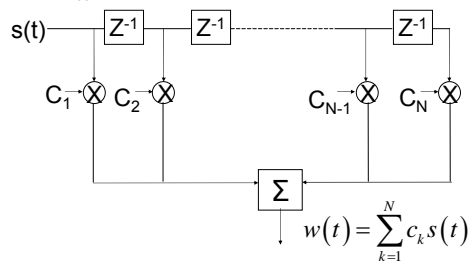
5-Year Plan

• Comprehensive examination of the characteristics of common channel models

• Determine the performance of common receiver structures under each model. Infer how channel characteristics impact a system

• Apply models and channel understanding to aspects of receiver design such as:

• multipath diversity

• channel estimation