



Senior Design Project in Electrical & Computer Engineering



Ultra-Wideband Radar "Seeing" Through Walls

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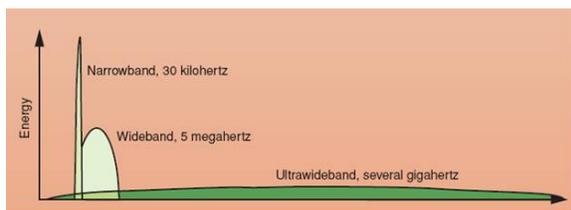
Can the radar see through anything?

Ultra-wideband is a classification of bandwidth that has low energy dispersed over a large number of frequencies. The ultra-wideband pulse is extremely short in time duration encompassing a several gigahertz bandwidth; these signal properties allow it to penetrate everything **but solid sheets of metal and water**. This is important for urban warfare or search and rescue environments in order to be able to see through a building's walls and be able to determine the location of all personnel within the building and to be able to accurately predict the thicknesses and material of each wall.



LOOKING OVER: Innovative radar systems can look through a wall and create an image of what's on the other side.

An Application of the Ultra-Wideband Radar



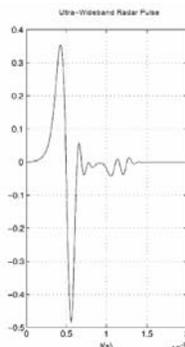
Comparison of Bandwidths to Energy Distributed

Why use ultra-wideband radar?

The purpose of my project is to use the ultra-wideband radar, developed by LLNL, to create a method to find the blue-print image of any building by flying over the building or driving around it. My portion of the project is to be able to determine the thickness of the wall without knowing the building material.

How to do to understand signal propagation?

- Use Wireless InSite, a signal propagation modeling software, to build models of wall using ultra-wideband signals to simulate the propagation through various building materials
- Use signal processing techniques to determine the thickness of the wall
- Create a model using mathematical equations to describe how ultra-wideband signals propagate through walls



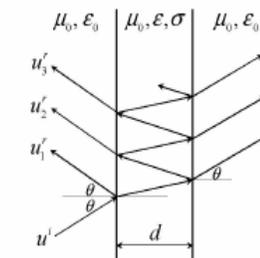
The Pulse the Ultra-Wideband Radar Transmits



The Handheld Ultra-Wideband Radar in Use "Seeing" Through a Wall



An Ultra-Wideband Radar Antenna



Displays How the Ultra-Wideband Signal Propagates Through a Wall

Electrical Engineering (EE) and Ops Research (OR) mold together...

- Determine how to find wall thickness
 - Examine power spectral density from the received vs. transmitted signal (EE)
 - Find the frequency response of the wall (EE)
 - Use deconvolution methods (EE)
- Create simplistic wall models in Wireless InSite (OR)
 - A transmitting antenna placed on one side of the wall and the receiving antenna placed on the other side
 - Using the same antenna for transmitting and receiving the ultra-wideband signal

What am I working on?

1. Finish mathematical model (in progress)
2. Create simplistic models using Wireless InSite (in progress)
3. Test wall thickness techniques on simulated data from Wireless InSite model (March)
4. Test techniques on actual data taken at LLNL (April)



The Micro-Power Impulse Radar Group During June 2006