

Ultra-Wideband Waveform Tutorial

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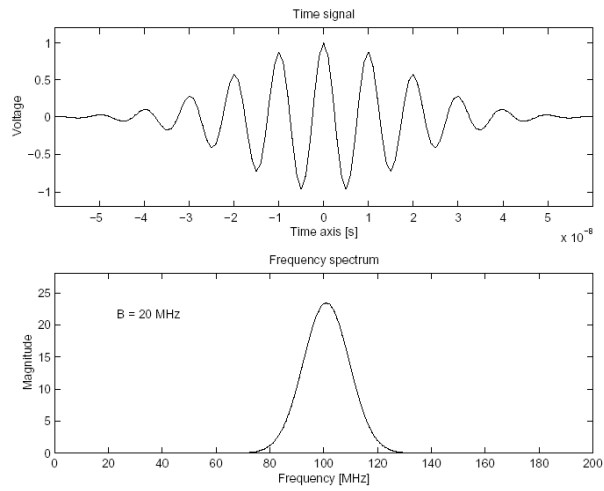
What is UWB?

- Definition
 - Fractional Bandwidth: $FB > 0.25$ or $BW > 500\text{MHz}$
 - Where

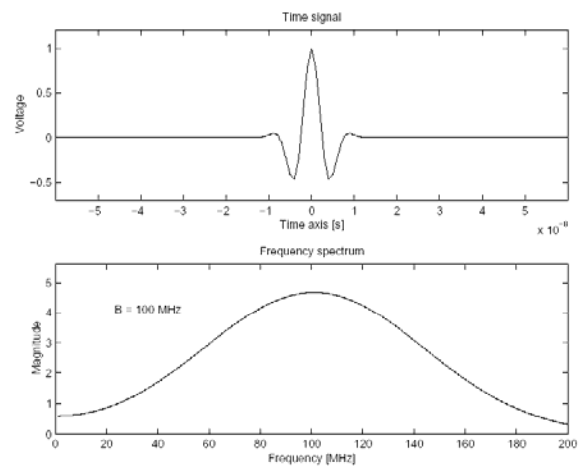
$$FB = \frac{2(f_H - f_L)}{(f_H + f_L)}$$

- Example $f_L=1\text{GHz}$ and $f_H=3\text{GHz}$ gives $FB = 1$

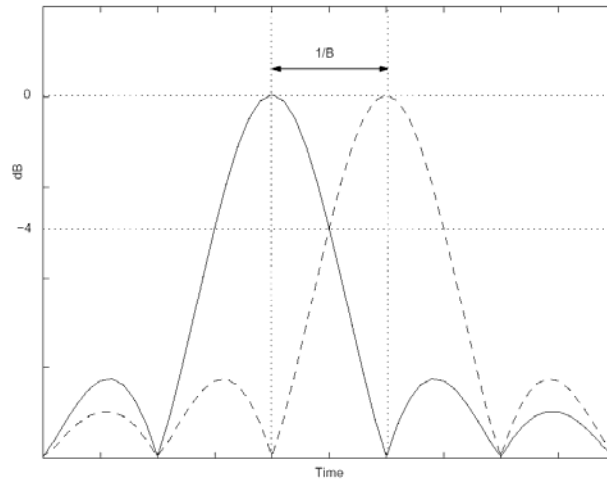
Resolution – Bandwidth FB = 20%



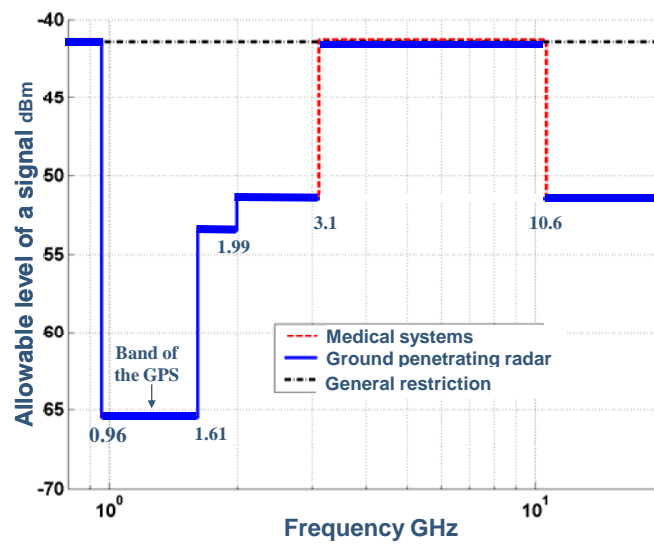
Resolution – Bandwidth FB = 100%



Range Resolution



Radiation level



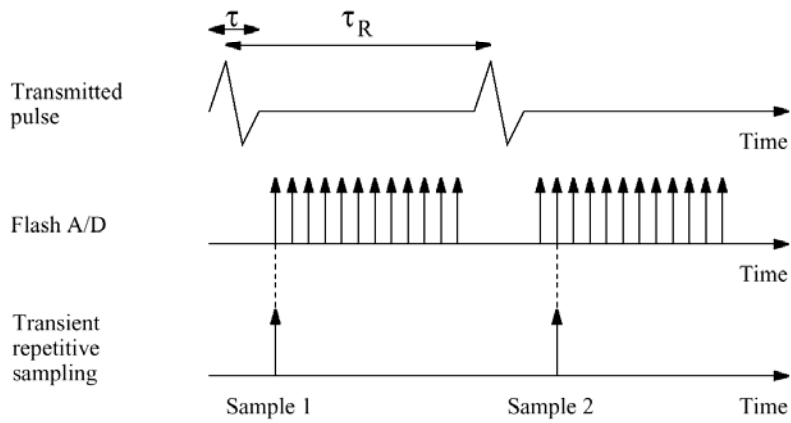


UWB waveforms

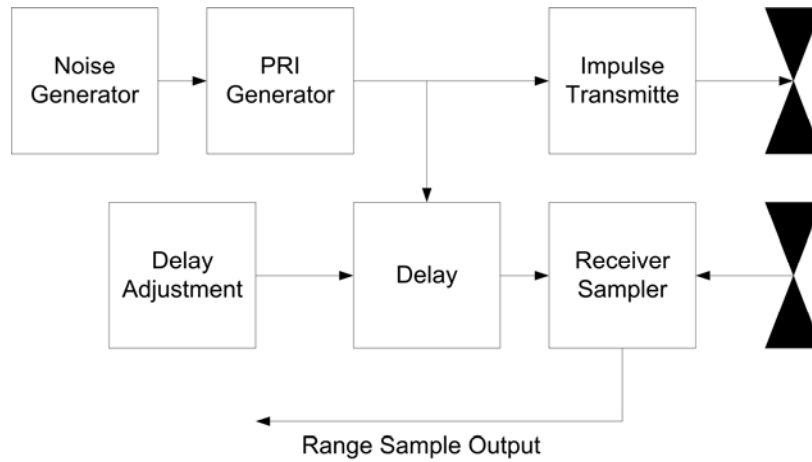
- UWB signals is very often several GHz wide
- Difficult to collect all the spectrum all the time.
- All UWB waveforms has a way to reduce sampling speed



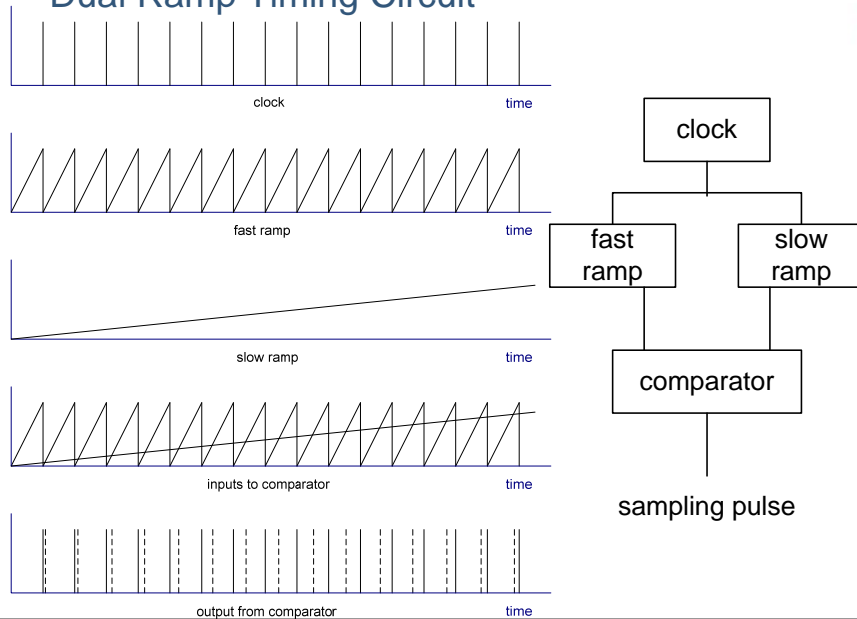
Impulse Radar



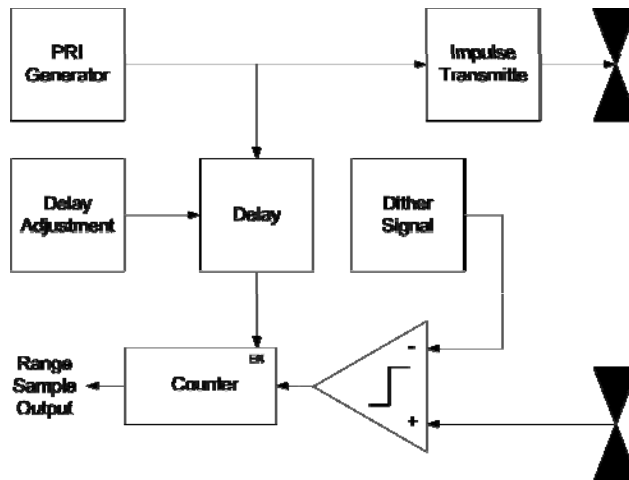
Sequential Sampling Receiver



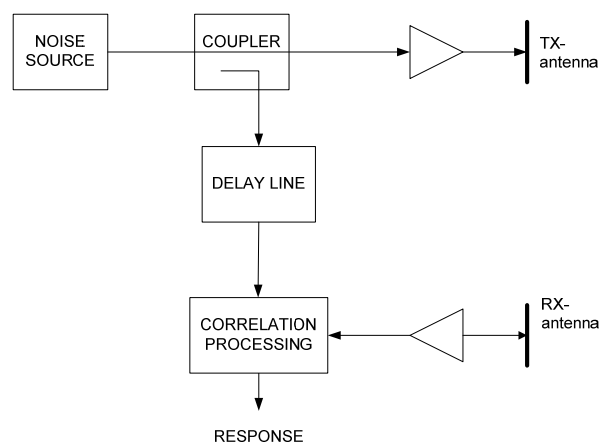
Dual Ramp Timing Circuit



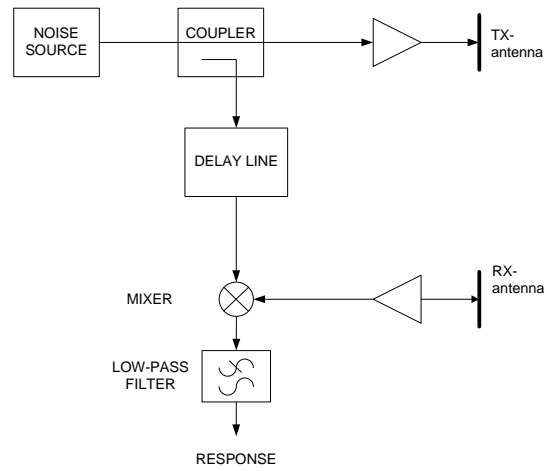
Single Bit Receiver



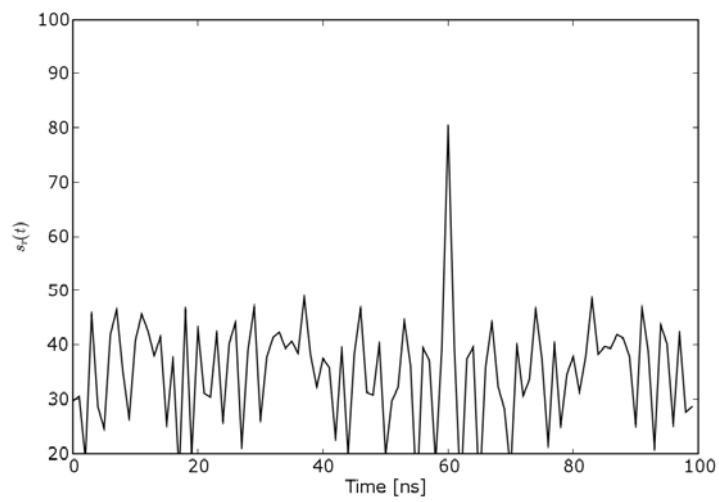
Block diagram of a noise radar



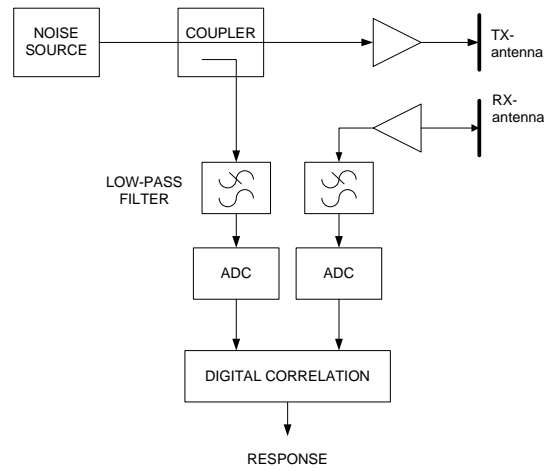
Analog correlation receiver



Range response

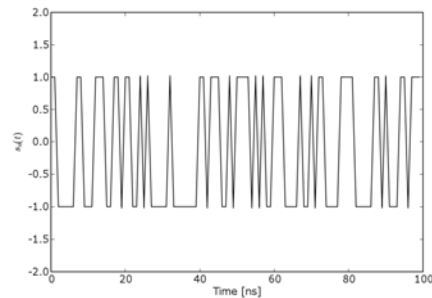
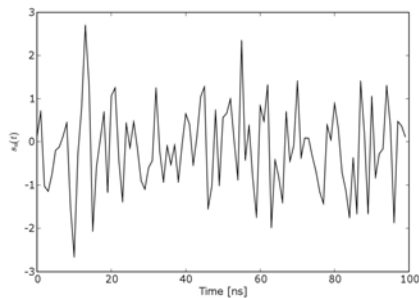


Digital correlation receiver

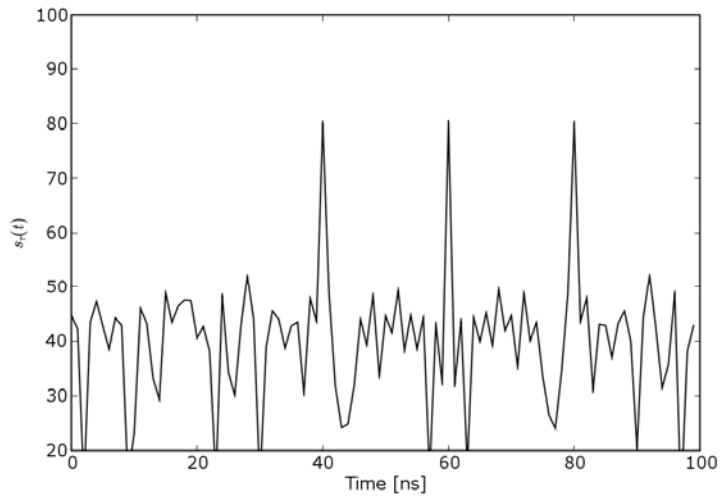


Multi vs. One bit ADC

- Sign bit i.e. 1 if $s(t) \geq 0$ and -1 if $s(t) < 0$



3-reflectors Multi-bit ADC

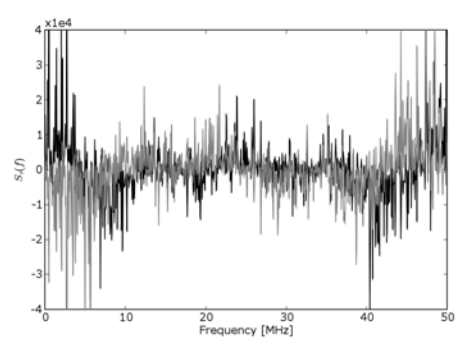
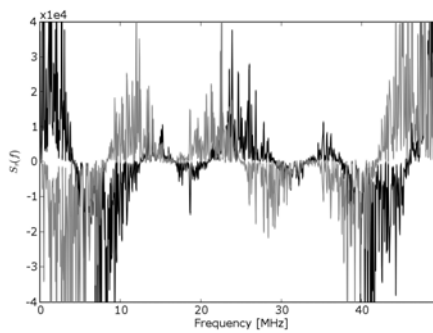


3-Reflectors

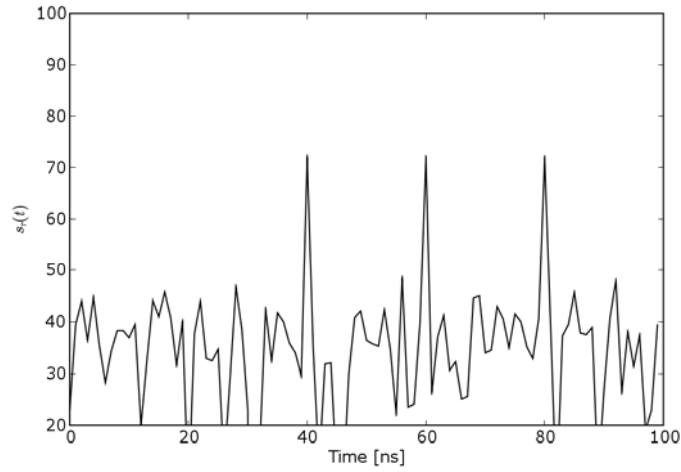


- Multi bit

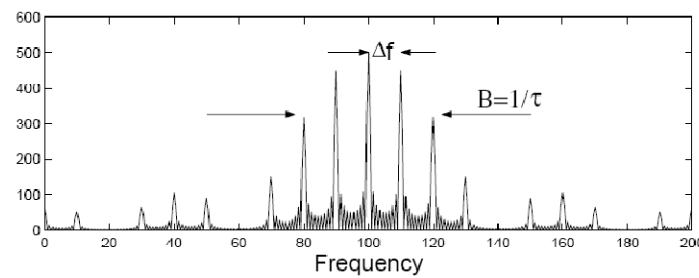
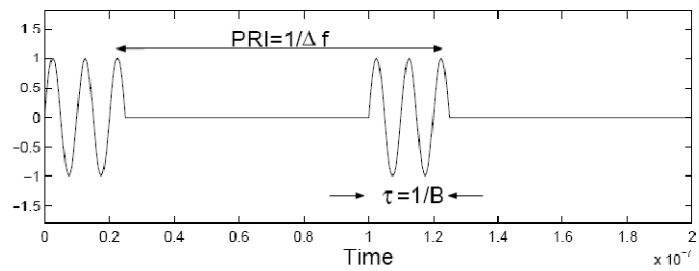
1-bit



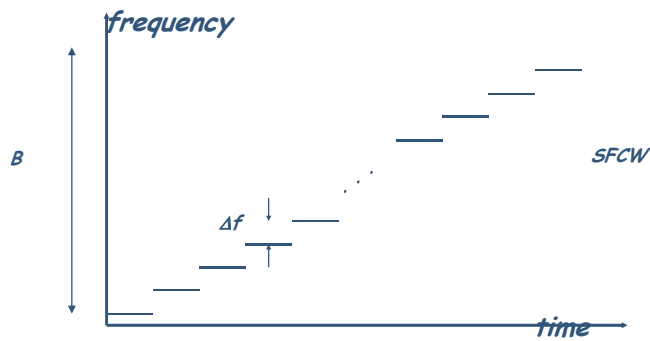
3 – Reflectors One – bit ADC



Pulse Train Spectrum



Step-frequency radar



Step Frequency Waveform

