Low Cost Networked Radar and Sonar using Open Source Hardware and Software

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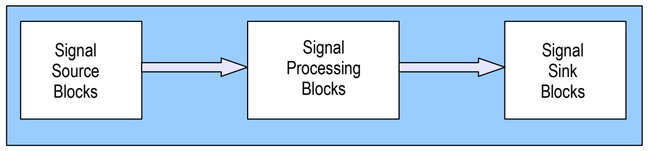
Project Introduction

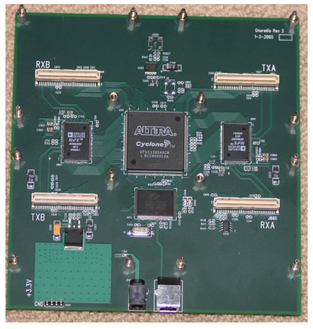
Experimental and educational applications of radar and sonar hardware would often be facilitated by access to a flexible, digital transceiver. This hardware should be easily reconfigured to implement different transmit waveforms, and sampling requirements. It would be possible to compromise very wide bandwidth in such an environment. This project involves the development of a digital transceiver based on Open Source hardware and software from the GnuRadio project.

GNU Radio

A flexible open source software application building frame work that serves for developing small scale systems, quick prototyping, and for educational purposes



Universal Software Radio Peripheral



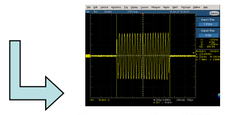
- usb 2.0 via Cypress FX2
- Altera Cyclone FPGA
- 4x 14 bit DAC's capable of 128 M samples/sec
- 4x 12 bit ADC's capable of 64 M samples/sec
- Interchangeable daughterboard front-ends.

SDR hardware solution. A single hardware interface to many different RF channel types. Reconfigurabilty enables applications like FM radio, TV, GPS, Radar and Sonar. Daughterboards provide RF frontends for more powerful applications by allowing access to higher frequency bands.

Prototype Sonar System

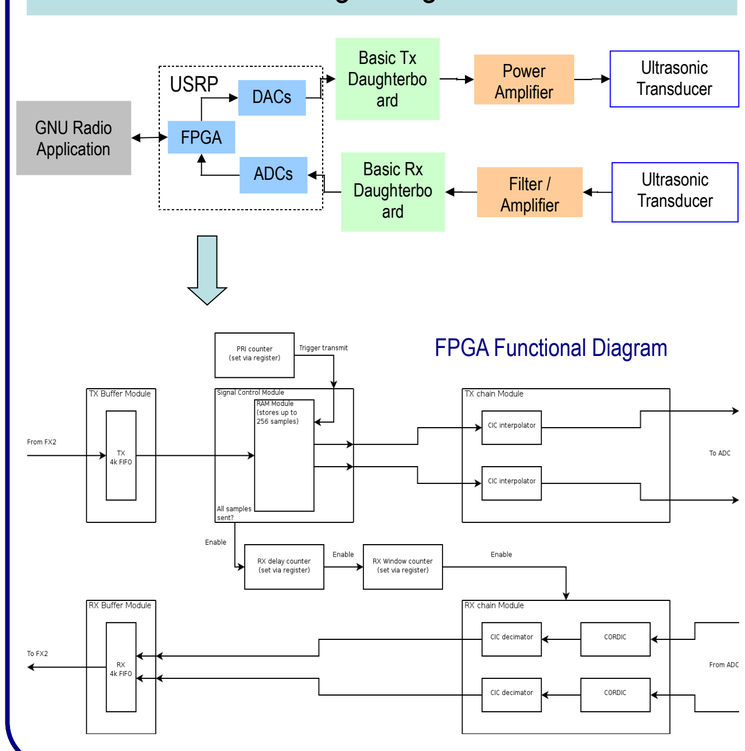
Bandwidth	2	kHz
Pulse Length	1	ms
PRI	16.38	ms
Range Resolution	8	cm
Tx PGA Gain	20	dB
Rx PGA Gain	20	dB
ADC Range	2	V p-p

- SONAR system using ultrasonic transducers
- Chirp centre frequency at 40 kHz
- Linear chirp signals created in software as a pre-built samples set

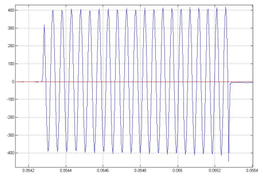


Chirp captured from USRP

Design Diagram

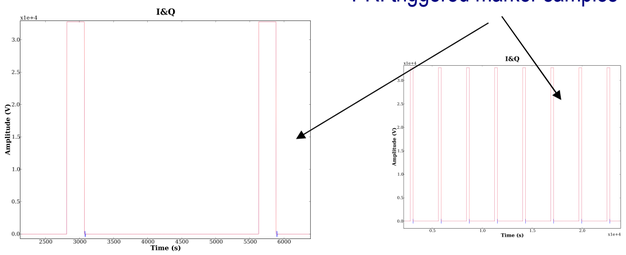


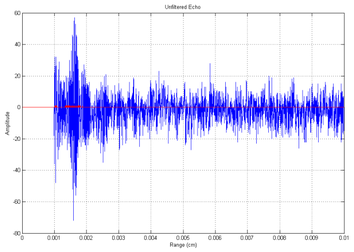
System Output



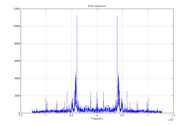
Fed back output showing the USRP capturing the transmitted pulse

Raw received data showing the PRI triggered marker samples





Echo recorded from a stationary object



Echo spectrum

Further Development

- Development of a USRP and GNU Radio based active radar prototype
- Development of a passive coherent location prototype using the USRP TV receiver daughterboard
- Development of a small scale netted radar prototype using the USRP and GNU radios existing support for IP interconnectivity and distributed clocks

References

http://www.ettus.com/
http://www.gnu.org/software/gnuradio/

Radar Remote Sensing Group, Department of Electrical Engineering, University of Cape Town, Rondebosch, 7701, South Africa
http://www.rrsg.uct.ac.za