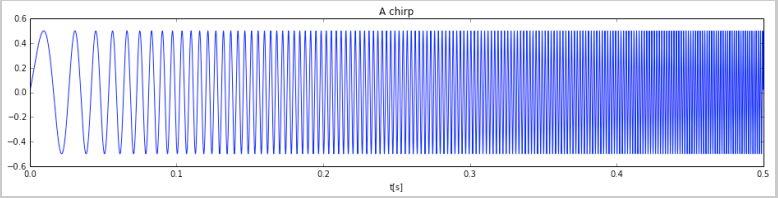
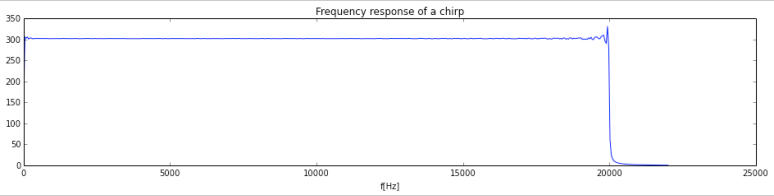
EE123 Digital Signal Processing

Lecture 12

Lab1

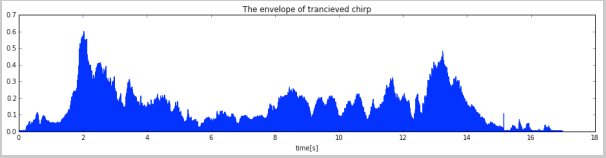
- Generate a chirp

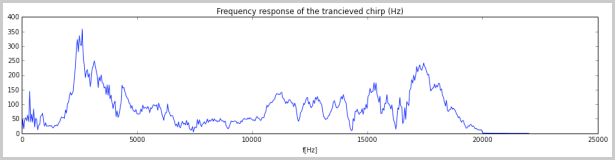


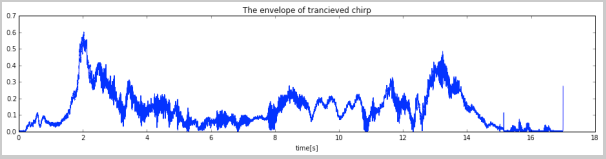


Lab1

- Play and record chirp

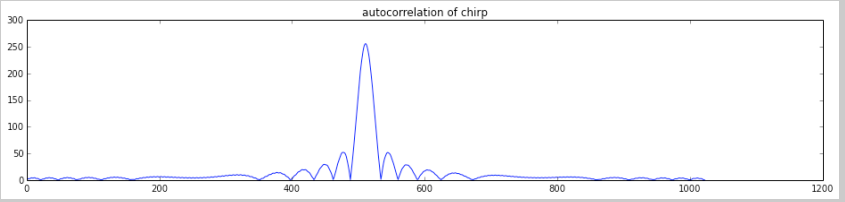


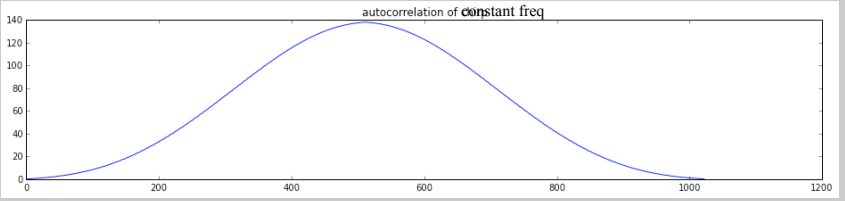




Lab 1

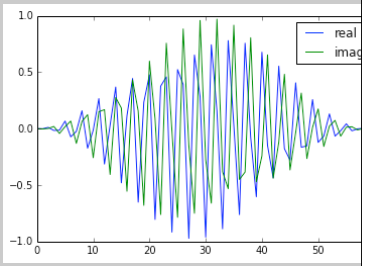
- Auto-correlation of a chirp - pulse compression



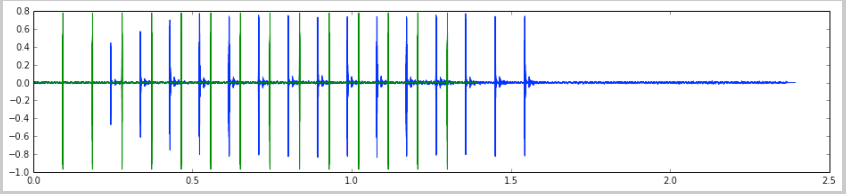


Lab I part II - Sonar

- Generate a pulse - analytic
- Use real part for pulse train
- Transmit and record

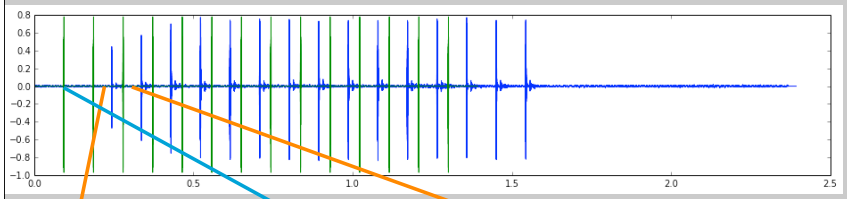


Sent and recorded:

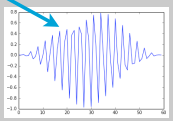


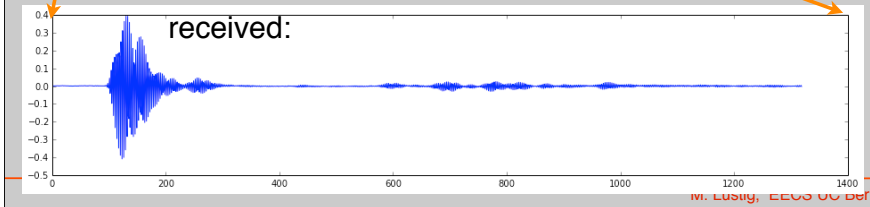
Lab I part II - Sonar

- Extract a pulse



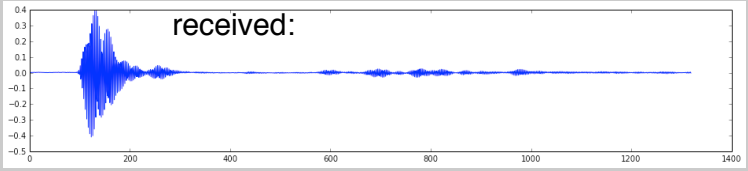
sent:



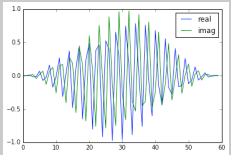


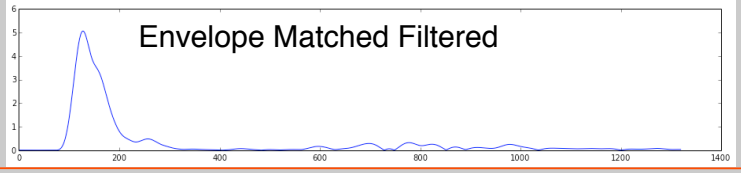
Lab I part II - Sonar

- Matched Filtering



Filter:

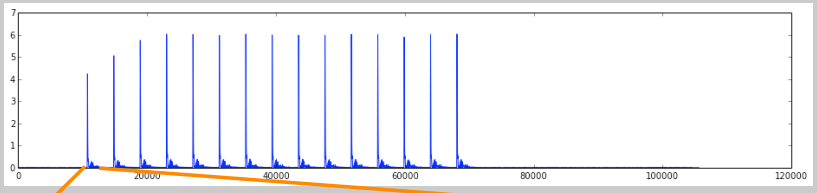


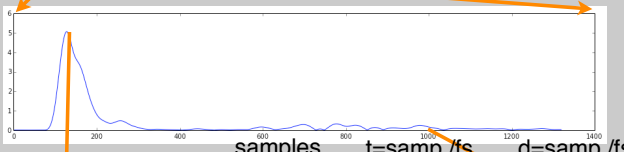


Lab I part II - Sonar

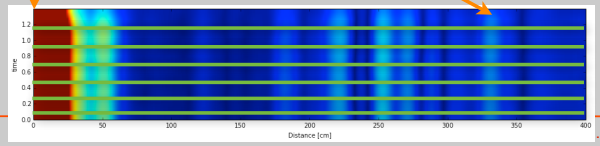
- Display echos vs distance

Matched Filter:



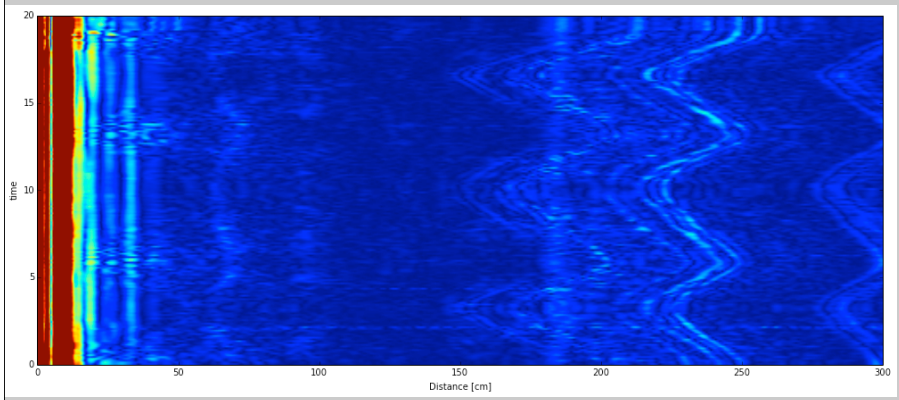


samples t=samp /fs d=samp /fs *v_s



Lab I part II - Sonar

- def sonar(Npulse, f0, f1, fs, Nseg, Nrep, T=20,maxDist=400,vmax=0.2):
- Play with different parameters: f0-f1 10,000 - 19000 Npulse = 300
  - change range of frequencies, change pulse length



SDR Stuff

- Samples you measure from the SDR are COMPLEX! WHY?
- Aren't physical signals real??????

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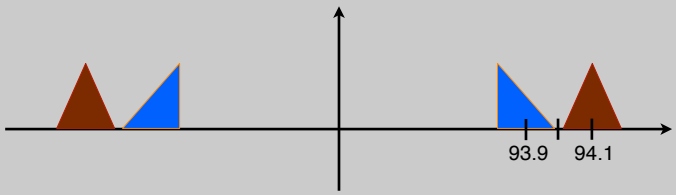
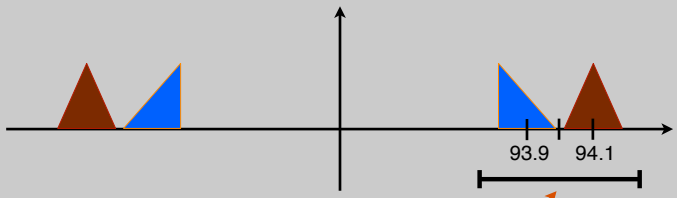


SDR Stuff

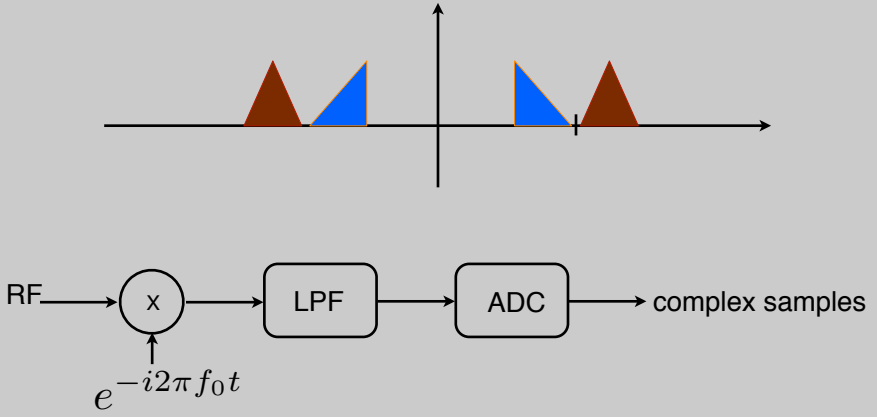
- With the SDR we look at part of the spectrum
- Example:
  >> rtl_sdr -f 94e6 -s 5e5



samples represent this freq. band

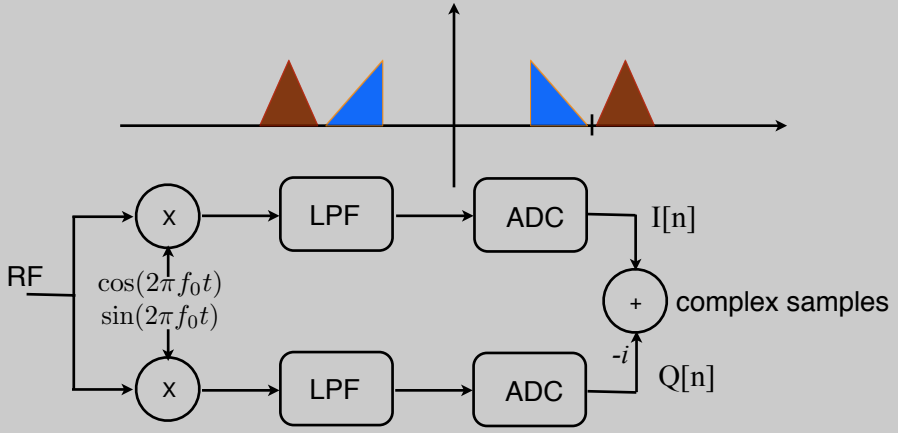
SDR Stuff

- How is it implemented?



SDR Stuff

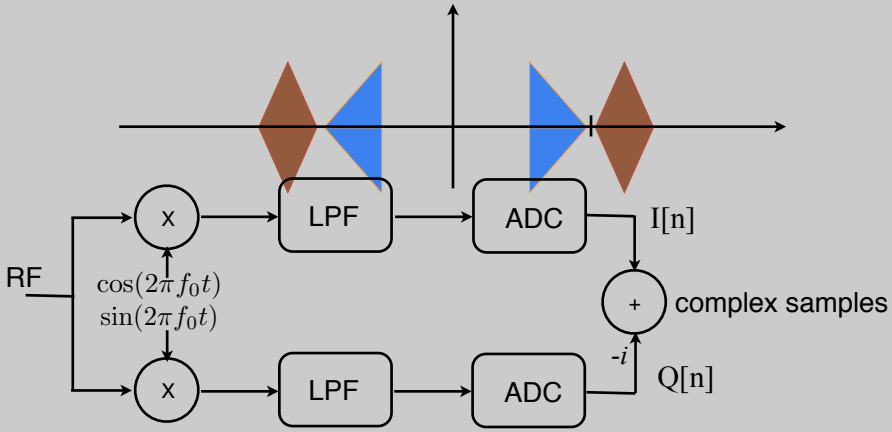
- How is it physically implemented?



$$e^{-i2\pi f_0 t} = \cos(2\pi f_0 t) - i\sin(2\pi f_0 t)$$

SDR Stuff

- How is it physically implemented?



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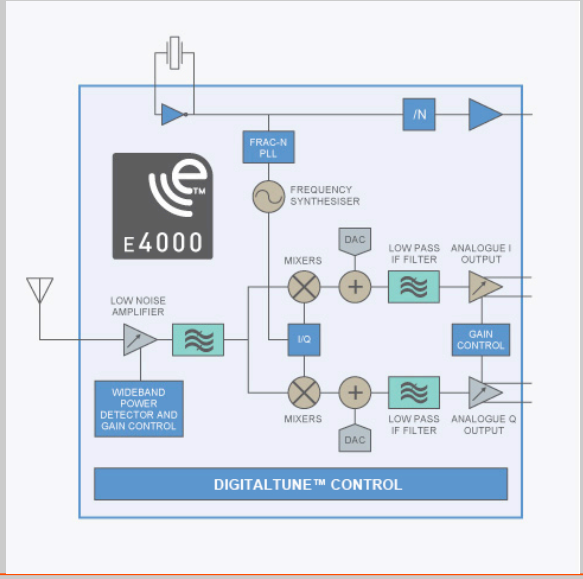
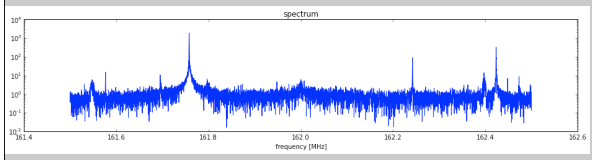
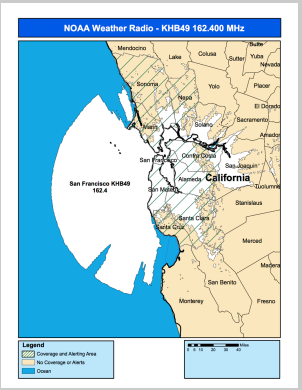


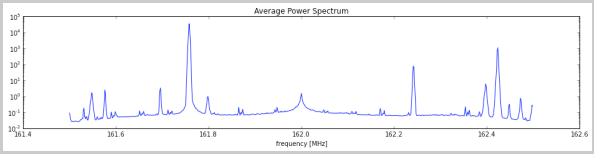
Lab I part III - SDR

- Get samples around 162Mhz
  - –Compute DFT 8000



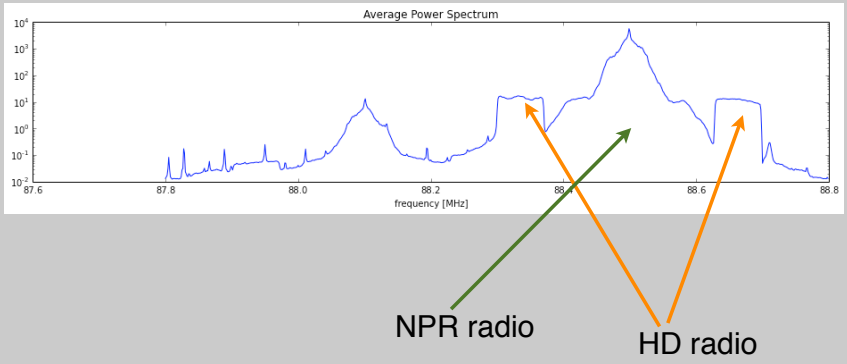


  - –Compute average DFT of many windows size 800

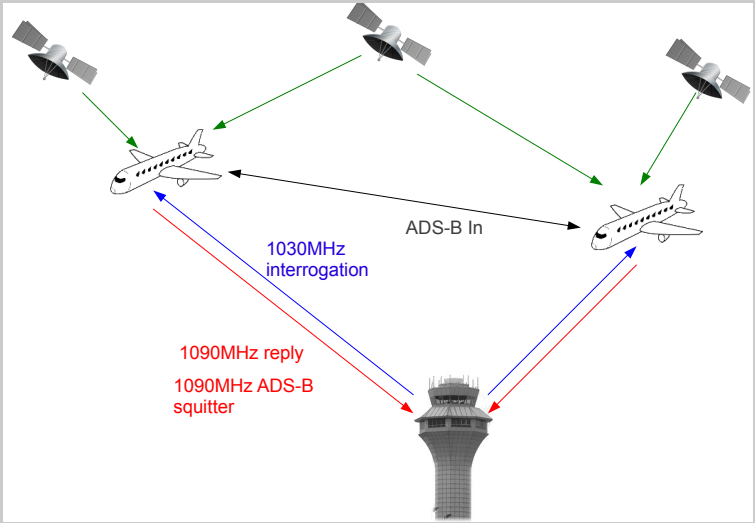


Lab I part III - SDR

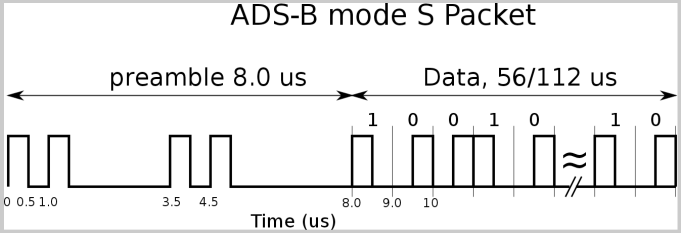
- Compute spectrum of FM radio around 88.3MHz

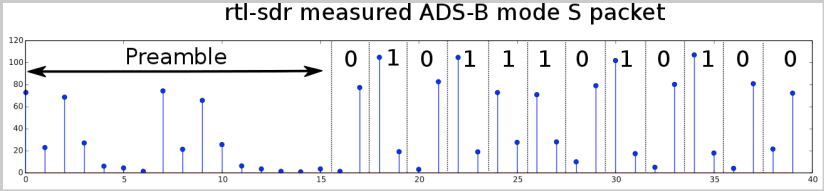


ADS-B



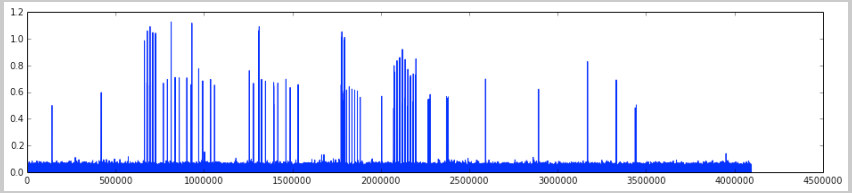
ADS-B



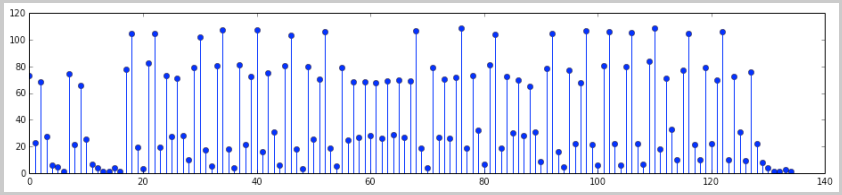


ADS-B

- Acquire 1 seconds

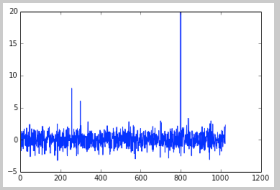


- Extract 1 packet

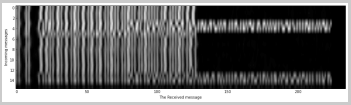


Detect Preamble

- Energy:
  - –Median and MAD to estimate noise
  - – Set threshold based on noise



- Using cross correlation



$$\hat{R}_{xy}[n] = \frac{\sum_{k=0}^{15}(x[n+k]-\hat{x}_n)(y[k]-\hat{y})}{\|x[n]-\hat{x}_n\| \cdot \|y-\hat{y}\|}$$

- Using Logic

1's bigger than 0's