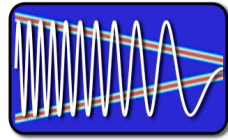


EE123

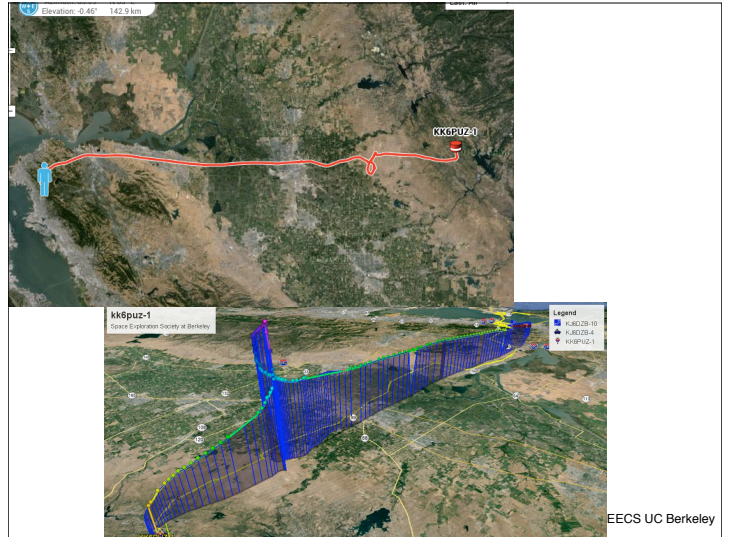


Digital Signal Processing

Lecture 22

Lab 4: Frequency Calibration using GSM Compressed Sensing

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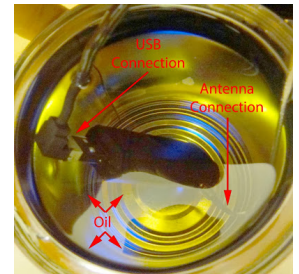


Solar-Terrestrial Data/Predictions at www.qrz.com			
18 Mar 2015 1500 GMT	Current Solar	Band	Day Night
SFI 116 SN 060		80n-40n	Poor Poor
A 116 K 5		30n-20n	Poor Poor
XRY C1.4 304A 142.6		17n-15n	Fair Fair
Aur 5 Lat 62.5°		12n-10n	Poor Poor
Bz -0.3 SM 561.5	Geomag Field	MIN STRM	
PF 0.1 EF 651.0	Sig Noise Lvl	S4-S6	
MUF Bdr 17.16 @ 1445	CME (UTC)	None	
EME Deg Good			

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Lab 4

- SDR crystal oscillator has often has offset
- Also drifts with temperature
- Cellphones do the same!



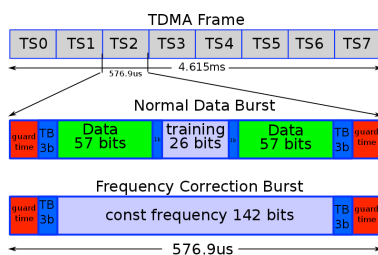
- GSM protocol has built in synchronizations

<http://sdrformariners.blogspot.com/2013/12/cooling.html>

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GSM-850

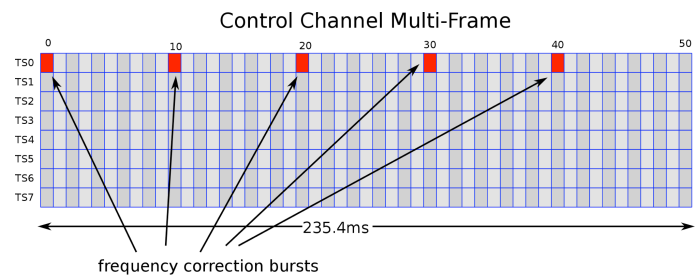
- Frequencies 200KHz channels
 - Uplink 824-849
 - Downlink 869-849
- TDMA: Time division multiple access



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GSM Frequency Correction Channel

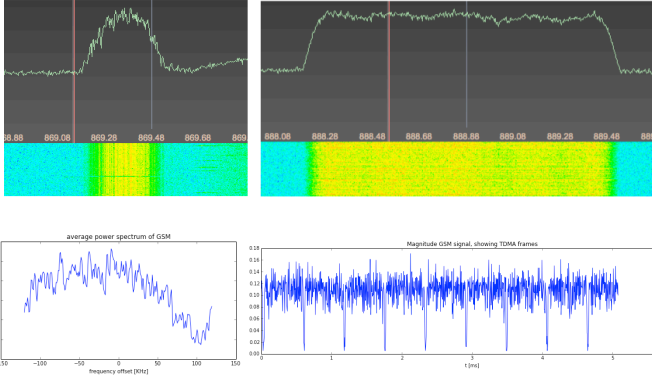
- Pure frequency bursts @67.7083KHz



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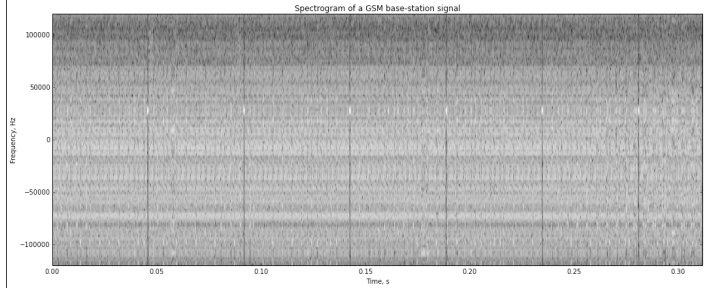
How to find GSM Base Stations

GSM spread spectrum



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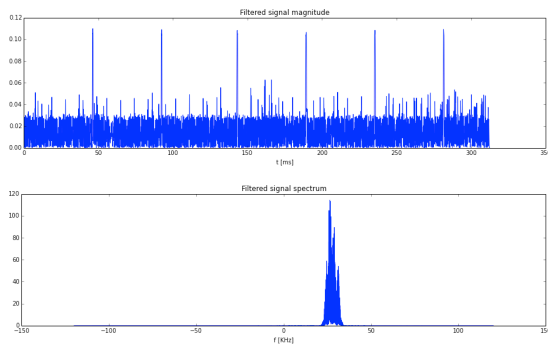
Spectrogram of GSM



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How to find Bursts?

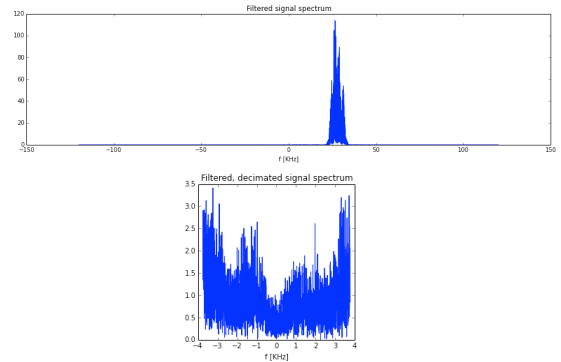
- Use Bandpass filter and compute magnitude of result



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How to find Bursts?

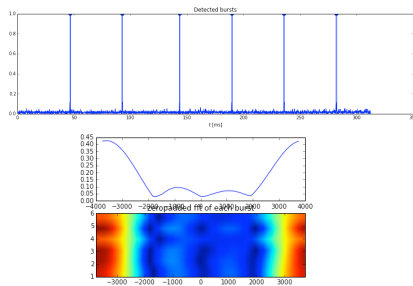
- Can process at lower rate!



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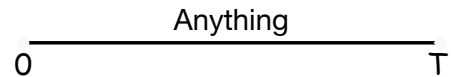
Detect Bursts and Compute Frequency

- Detect bursts at low rate sampling
- Compute frequency
- Calculate the original frequency!



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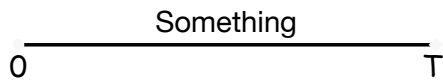
Compressive Sampling



Q: What is the rate you need to sample at?

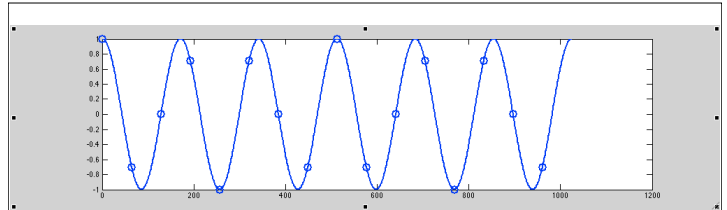
A: At least Nyquist!

Compressive Sampling



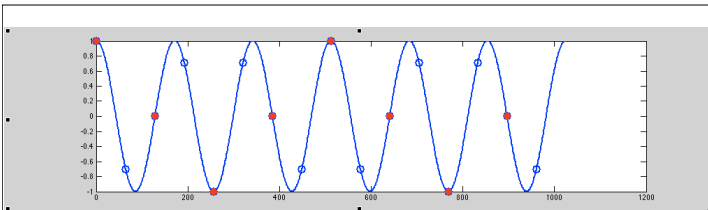
Q: What is the rate you need to sample at?

A: Maybe less than Nyquist....



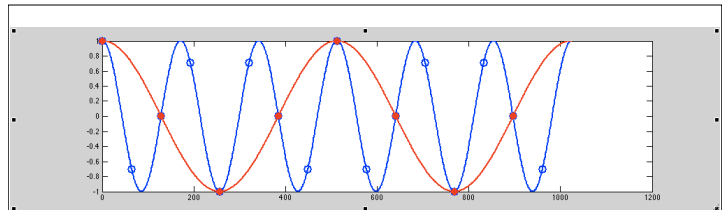
You are given samples of an harmonic function. You know there's only 1 frequency, but you don't know which.

1. Is it Nyquist sampled?
2. How would you reconstruct?



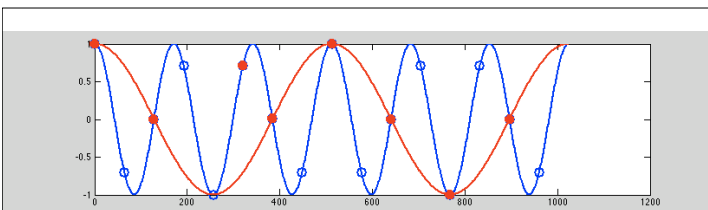
You collect half the samples at half the rate

1. Is it Nyquist sampled?
2. Can you reconstruct?



You collect half the samples at half the rate

1. What's the problem?
2. How can it be resolved?



Non-uniform sampling solves the ambiguity!

1. What if there are 2 frequencies? What would you do?

Image Compression

Images are compressible

Standard approach: First collect, then compress

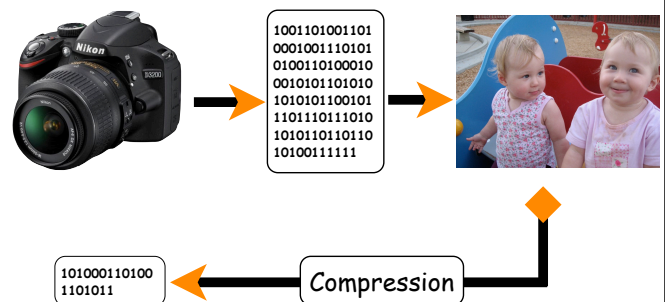
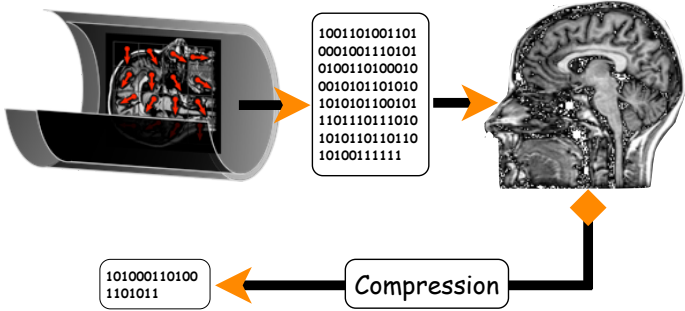


Image Compression

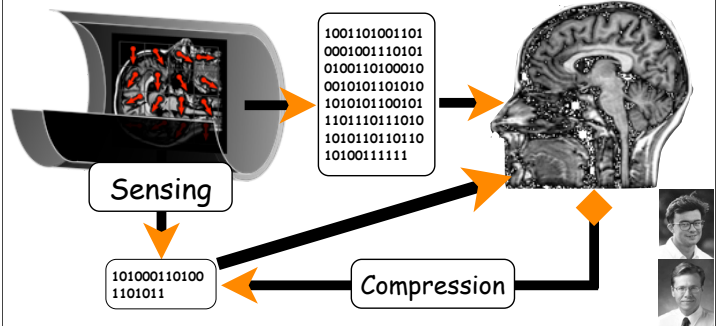
Medical images are compressible
Standard approach: First collect, then compress



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Compressed Sensing

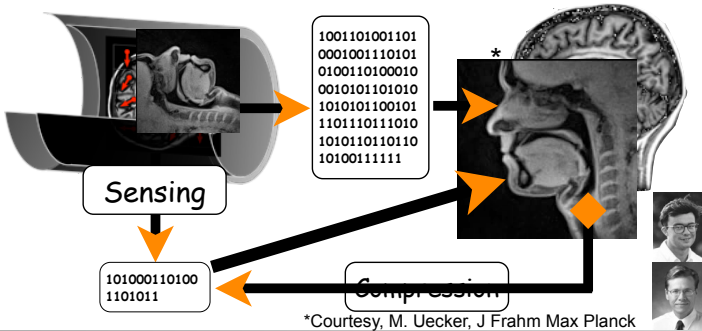
Medical images are compressible
Standard approach: First collect, then compress



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Compressed Sensing

Medical images are compressible
Standard approach: First collect, then compress



*Courtesy, M. Uecker, J Frahm Max Planck

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