SDR Lab Tutorial (Three Labs)

Nansai Hu

SDR

Software-Defined Radio, radio communication system which uses software for the modulation and demodulation of radio signals
http://en.wikipedia.org/wiki/Software-defined_radio

GNURadio

GNU Radio is a free software for building and deploying Software Defined Radios (SDR).
SDR turns radio hardware problem into software problems. With GNU radio, it is possible to make a radio in an easy way.
http://en.wikipedia.org/wiki/GNURadio

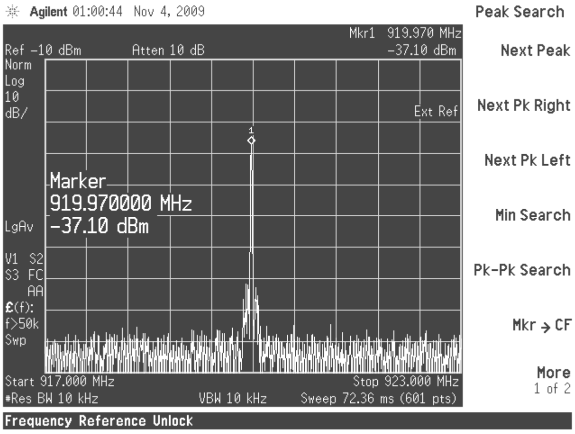
USRP

The Universal Software Radio Peripheral (USRP) is a family of computer-hosted hardware for making software radios. The USRP is intended to be a comparatively inexpensive hardware device facilitating the building of a software radio.
USRP hardware connects to a host computer through a high-speed USB or Gigabit Ethernet. This connection enables host-based software to control the USRP and prepare signals for transmission or reception.
http://en.wikipedia.org/wiki/Universal_Software_Radio_Peripheral

1. LAB1: Radio in air

In lab1, run a demo file: lab1.py

- Observe the generated signal in corresponding instruments.
- Describe what kind of radio it is.

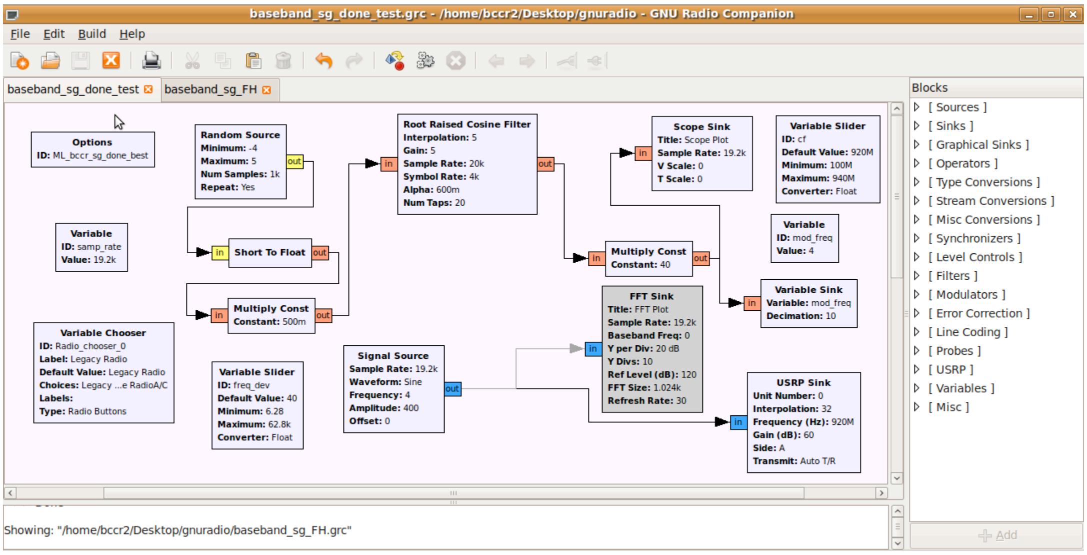


```
Agilent 01:00:44  Nov 4, 2009
                                          Mkr1  919.970 MHz
Ref -10 dBm          Atten 10 dB                -37.10 dBm
Norm
Log
10
dB/                                                 Ext Ref

      Marker
      919.970000 MHz
LgAv  -37.10 dBm

V1  S2
S3  FC
    AA
£(f):
f>50k
Swp
Start 917.000 MHz                         Stop 923.000 MHz
#Res BW 10 kHz       VBW 10 kHz     Sweep 72.36 ms (601 pts)
Frequency Reference Unlock
```

2. Lab2: Design your own radio

Using GRC

- ◆ Design a similar radio in Lab1 in plug-and- drag by existing module.
- ◆ At least see an active signal waveform in the air.



Options
ID: ML_bccr_sg_done_best

Random Source
Minimum: -4
Maximum: 5
Num Samples: 1k
Repeat: Yes

Root Raised Cosine Filter
Interpolation: 5
Gain: 5
Sample Rate: 20k
Symbol Rate: 4k
Alpha: 600m
Num Taps: 20

Scope Sink
Title: Scope Plot
Sample Rate: 19.2k
V Scale: 0
T Scale: 0

Variable Slider
ID: cf
Default Value: 920M
Minimum: 100M
Maximum: 940M
Converter: Float

Variable
ID: samp_rate
Value: 19.2k

Short To Float

Multiply Const
Constant: 40

Variable
ID: mod_freq
Value: 4

Multiply Const
Constant: 500m

FFT Sink
Title: FFT Plot
Sample Rate: 19.2k
Baseband Freq: 0
Y per Div: 20 dB
Y Divs: 10
Ref Level (dB): 120
FFT Size: 1.024k
Refresh Rate: 30

Variable Sink
Variable: mod_freq
Decimation: 10

Variable Chooser
ID: Radio_chooser_0
Label: Legacy Radio
Default Value: Legacy Radio
Choices: Legacy ...e RadioA/C
Labels:
Type: Radio Buttons

Variable Slider
ID: freq_dev
Default Value: 40
Minimum: 6.28
Maximum: 62.8k
Converter: Float

Signal Source
Sample Rate: 19.2k
Waveform: Sine
Frequency: 4
Amplitude: 400
Offset: 0

USRP Sink
Unit Number: 0
Interpolation: 32
Frequency (Hz): 920M
Gain (dB): 60
Side: A
Transmit: Auto T/R

Showing: "/home/bccr2/Desktop/gnuradio/baseband_sg_FH.grc"

3. Lab 3: A radio by python

Design a radio in python.

- ◆ Achieve a frequency hopping radio

Tips: **Frequency-hopping** is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels.

4. Estimated time of each lab

◆ Requisites before start:	3 hour
◆ Lab1:	0.5 hour
◆ Lab2:	1 hour
◆ Lab3:	2 hour