

GNU Radio workshop - Tasks

March 4, 2018

1 Prepare GR Live

Boot into the Linux live distribution, and enable the Internet connection and change the keyboard layout.

1. Insert the USB stick into the computer, start the computer, press F9 and boot it into GR Live.
2. In the desktop, upper right corner: Press the \updownarrow symbol, choose "Internet (DHCP assigned)" in order to be able to connect to the Internet.
3. Upper right corner: Press the "En" symbol -> Text entry settings -> "+"-symbol -> choose Norwegian or your keyboard layout of preference. (Or open a terminal and run "setxkbmap no".)
4. Plug the USRP into the computer and verify that the "Pwr" LED is turned on.

Note: Any settings you modify or files you create will be wiped after reboot.

2 Set up and verify USRP source block

A signal generator has been set up to broadcast a simple signal around 144.1 MHz. Set up a flowgraph in GNU Radio Companion for reception and investigation of the signal.

Note: GNU Radio will use some time to flash the USRP with the correct firmware the first time the flowgraph is run. There is a console window in the lower left corner that can be extended to watch the progress.

Tips/things to try:

- The USRP source block needs a center frequency (f_c), a sampling rate ($samp_rate$) and a gain.
 - The "Variable"-block can be used to create variables, and "Qt GUI range" can be used to provide a slider that can be used to tune a variable live during operation.
 - Use scientific notation (1.0e09, ...) for longer numbers.
- Try out the various GUI widgets that can be found by searching for "Qt": Waterfall, constellation, frequency, time,
- Find out how you can set correct frequency axes in the plots.

- Select "Control panel: Yes" in the frequency GUI sink settings, and investigate settings during live operation like "Max Hold".
- Investigate how the USRP parameters affect e.g. the frequency plots.

3 FM receiver

Someone in your neighbourhood has set up an illegal pirate station! Locate the station, create an FM receiver and listen in on the dubious music. The broadcaster is located somewhere between 2.4 and 2.5 GHz.

- Investigate the frequency spectrum and time plot of the signal.
- GRC has an in-built WBFM-demodulator block. The quadrature rate of the broadcasted signal is specified to be 192 kHz.
- Play around with the gain, a power squelch and the sample rate to get the best possible/worst possible audio reception. You could also try band pass filters.

4 Rudimentary DAB+ receiver

While receiving AM or FM radio is rather simple, demodulating and converting DAB+ to audio is not. We can still investigate the signals, however. Here in Trøndelag, the DAB channels 12D and 12C are in use. Find the corresponding frequency range (->Google), and obtain a waterfall plot over both channels at the same time.

Further challenge (not verified that it is possible by the course organizers):

Compile and install the out-of-tree module `gr-dab` (<https://github.com/kit-cel/gr-dab>), and based on its examples, demodulate the DAB+ metadata (fast information channel, FIC) and find the radio channel names.

5 Investigate your surroundings

Proposals for signals to investigate:

- Akademisk Radioklubb's morse beacons at 144.463 MHz and 432.463 MHz. NOTE: The signal will be very weak with our antennas. If you are able to optimize the reception, plot a time plot to see the morse code in action.
- WiFi signals.
- LTE (see also the module `gr-lte`)