The Inspector (gr-inspector)

Signal Analysis Toolbox

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Introduction

Signal intelligence describes the gathering of information out of intercepted radio signals with unknown origin and unknown parameters. GNU Radio has already the ability to do signal intelligence, but it is only possible through some detours. Real-time signal intelligence is hardly possible. The tool `gqrx` has some of this ability (real-time AM/FM demodulation), but there is no final solution for this problem at this time. The target of this project is to develop an easily accessible and extendible solution for this workflow including automatic signal detection and automatic modulation classification. In addition, an OFDM parameter estimation block is included. Further deliverables for the future are a radio service allocation database, blind synchronization methods and an automatic demodulation block.

This project was accepted as Google Summer of Code 2016 project and was developed in cooperation with Christopher Richardson (ESA Summer of Code in Space student at GNU Radio).

Components

The toolbox consist of the follwing blocks:

Signal Detector Is able to perform energy detection on an input signal. The user can specify a threshold in dB or use an automatic threshold calculation by entering a sensitivity between 0 and 1.

Inspector GUI The GUI block uses QT and QWT to create a plot of the estimated PSD by the **Signal Detector** and marks the detected signal edges. By enabling manual selection, users can select own parts of the spectrum to get passed downstream.

Signal Separator Uses FIR filters for every detected/selected input signal to mix, filter and decimate this signal out of the input spectrum. All the signal samples get wrappen in a message and passed downstream.

Signal Extractor Takes messages from the **Signal Separator** and extracts only the samples belonging to the specified signal in the block parameters. The extracted signals get passed as a complex stream.

AMC Block Uses `tensorflow` to perform a modulation classification of the detected signals.

OFDM Estimator Estimates OFDM parameters like subcarrier spacing.

Flowgraph

The toolbox was developed with the following main flowgraph in mind. The **Signal Extractor** block assures the ability to append custom signal processing chains for users.

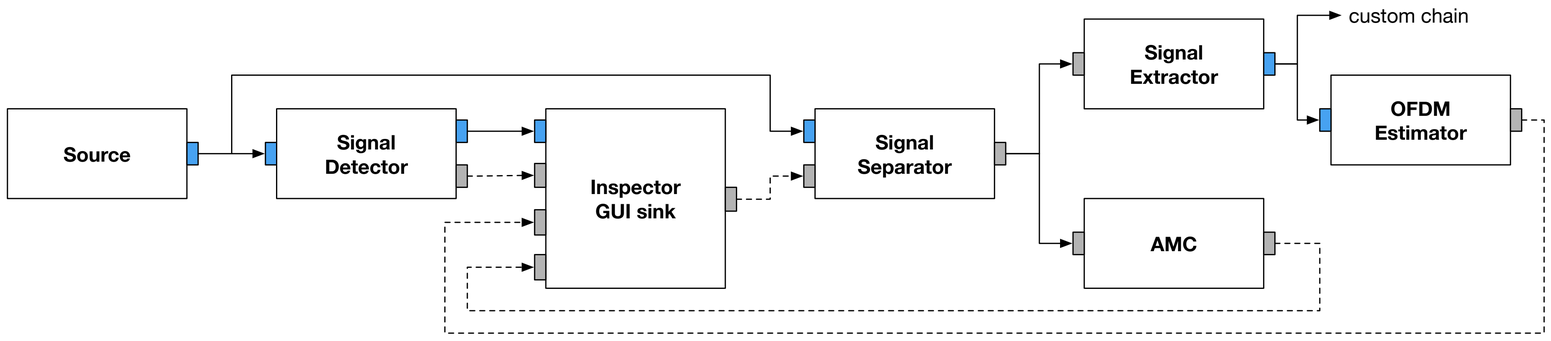

Figure 1: Example flowgraph

GUI

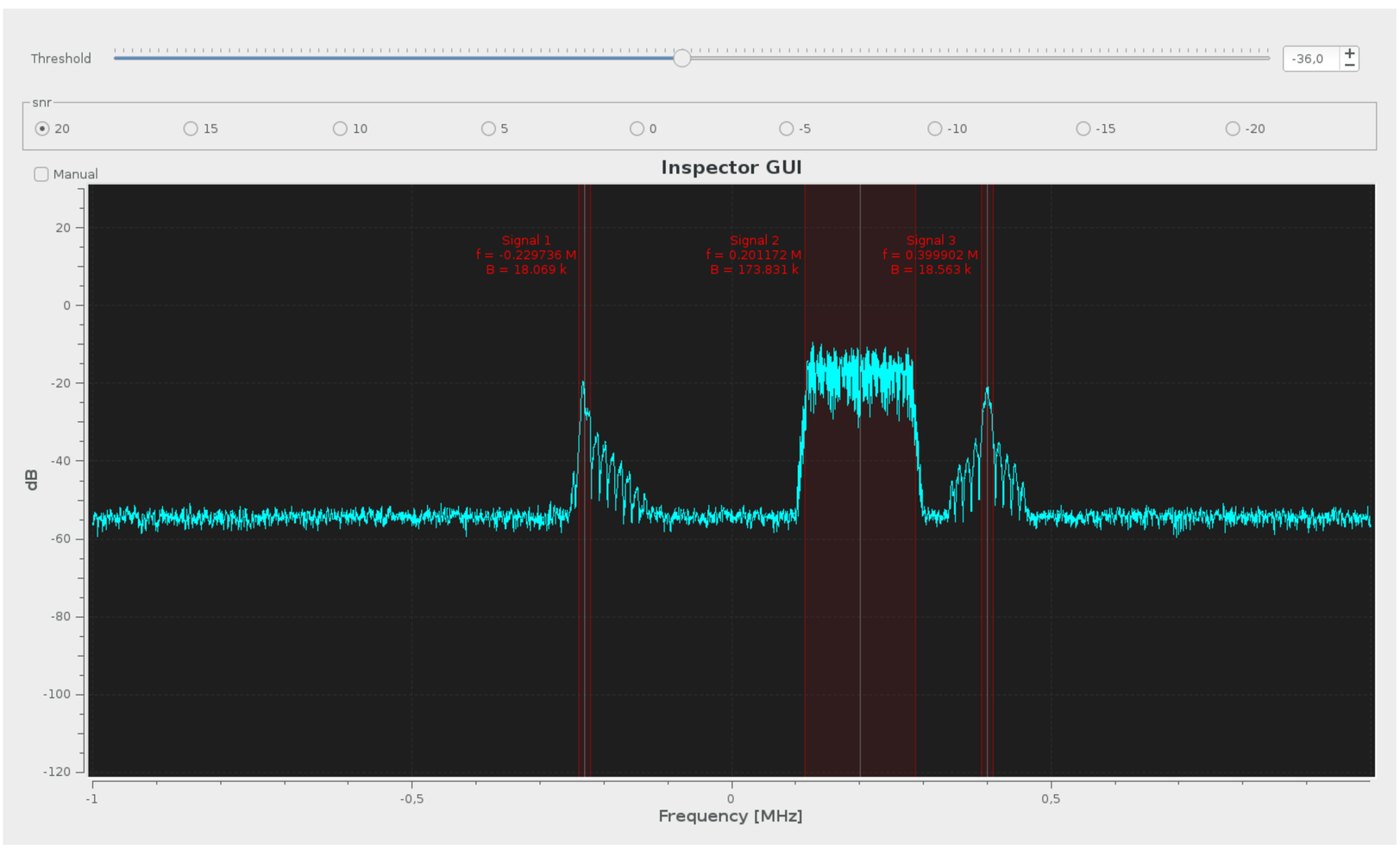

Figure 2: Inspector GUI

Materials & Methods

The following materials were required to complete the research:

- Curabitur pellentesque dignissim
- Eu facilisis est tempus quis
- Duis porta consequat lorem
- Eu facilisis est tempus quis
- Eu facilisis est tempus quis

The following equations were used for statistical analysis:

$$\cos^3\theta = \frac{1}{4}\cos\theta + \frac{3}{4}\cos 3\theta \tag{1}$$

$$E = mc^2 \tag{2}$$

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$$E = mc^2 \tag{4}$$

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The following equations were used for statistical analysis:

$$\cos^3\theta = \frac{1}{4}\cos\theta + \frac{3}{4}\cos 3\theta \tag{5}$$

$$E = mc^2 \tag{6}$$

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References

[1] J. M. Smith and A. B. Jones. *Book Title*. Publisher, 7th edition, 2012.

[2] A. B. Jones and J. M. Smith. Article Title. *Journal title*, 13(52):123–456, March 2013.

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