The Inspector (gr-inspector)

Signal Analysis Toolbox for GNU Radio

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Introduction

gr-inspector is an out-of-tree module for GNU Radio. The target was to develop a signal analysis toolbox with the following capabilities:

- Automatic signal detection
- Automatic Signal Classification (AMC)
- OFDM parameter estimation and synchronization
- GUI feedback

All these tasks should be available live during runtime. This project was part of Google Summer of Code and ESA Summer of Code in Space programs. The toolbox was developed by Sebastian Müller while the explicit AMC functionality was developed by Christopher Richardson.
asdf

Components

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 that get passed downstream. Analysis blocks can be connected to the GUI to display analysis results directly next to the specific signal.

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 wrapped in a message and passed downstream. Taps can be calculated during runtime or a precalculated taps file can be selected.

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. The input samples can be resampled to satisfy a constand output sample rate.

AMC Block TODO

OFDM Estimator Estimates OFDM parameters subcarrier spacing, symbol time, FFT lenght and CP length.

OFDM Synchronizer After performed estimation, the signal can be frequency synchronized and stream tags can be inserted at OFDM symbol beginnings.

Flowgraph

The toolbox was developed with the following main flowgraph in mind.

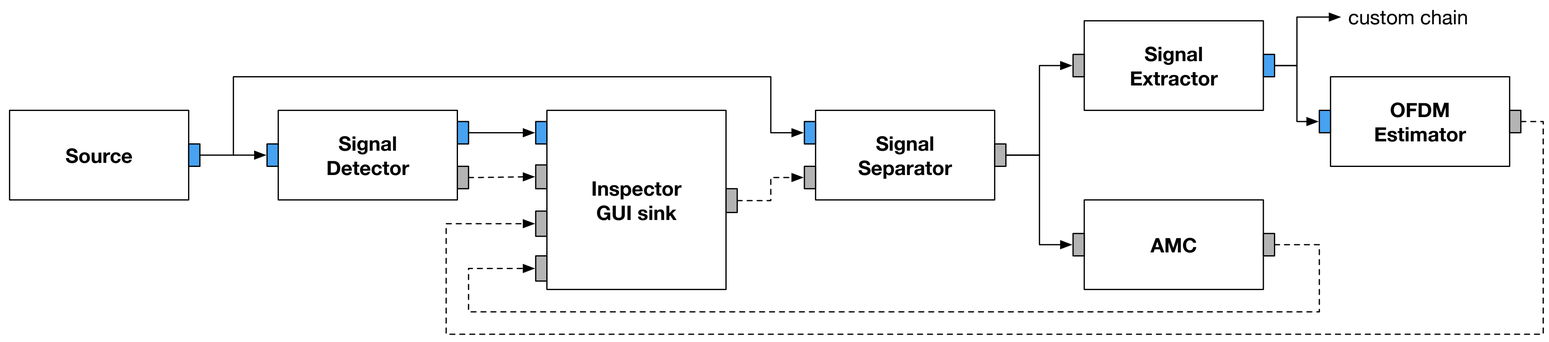

Figure 1: Example flowgraph

The **Signal Extractor** block assures the ability to append custom signal processing chains for users. Each analysis block can have a feedback message to the **Inspector GUI** to print their results there.

GUI

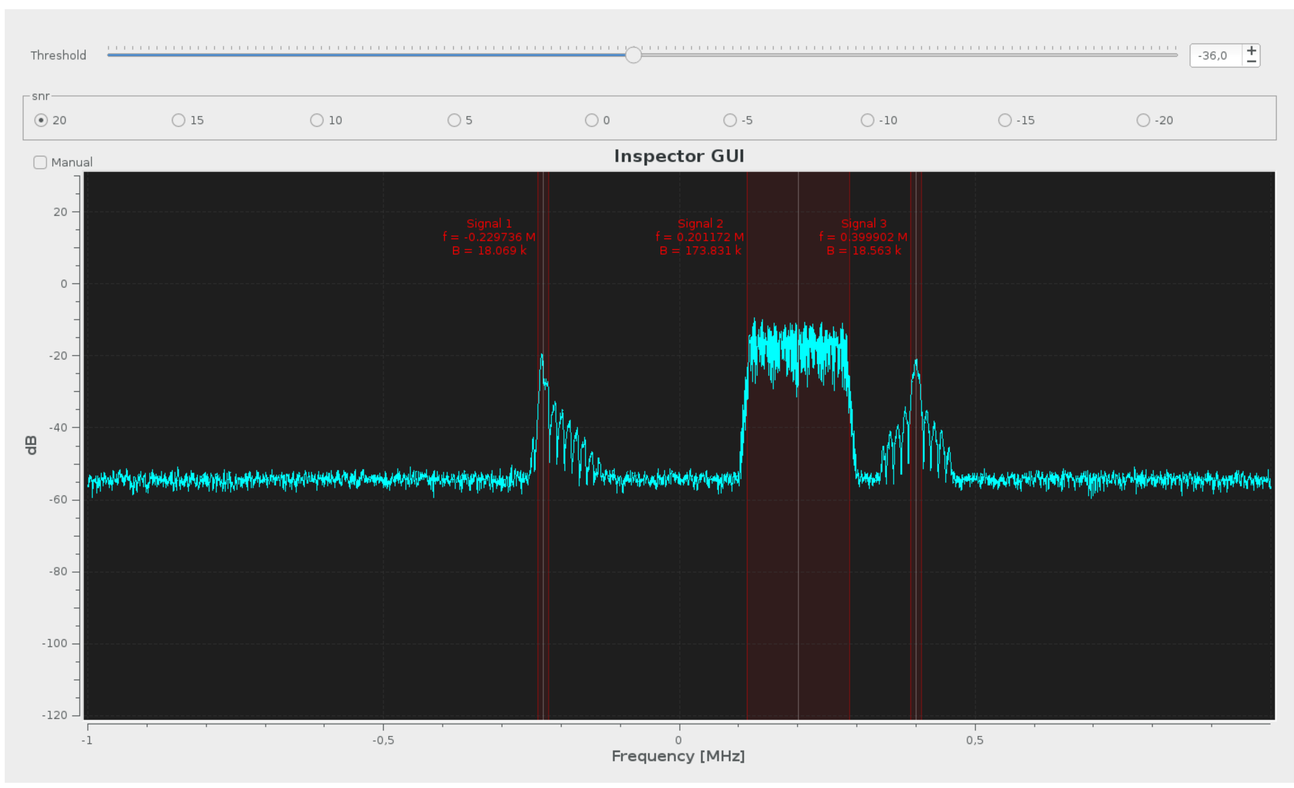

Figure 2: Inspector GUI

The GUI displays the input spectrum along with markers for all detected signals. Next to the graphical markers, information text is displayed. Each signal has a number and estimated **center frequency** and **bandwidth**. Distinct analysis toolboxes can provide **additional information** for specific signals, which will be appended to the info text.

Example

Along with existing GNU Radio blocks, a complete FM signal processing from receiving to demodulation can be performed live and automatically.

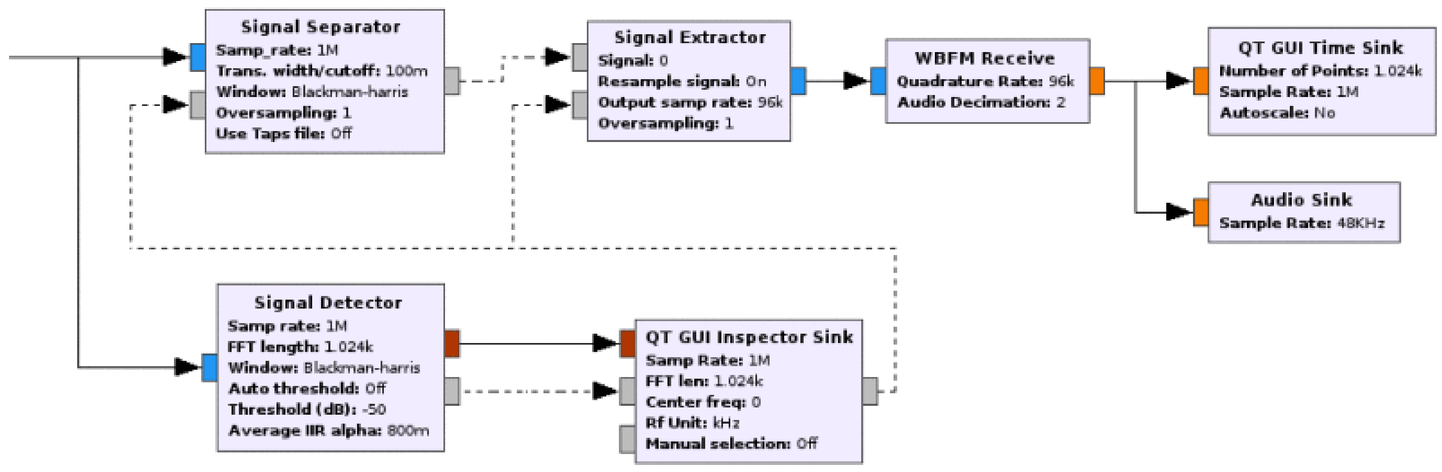

Figure 3: Live FM demodulation

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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