KiwiSDR as a new GNURadio source

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Abstract

By now, >300 world-wide distributed KiwiSDRs are online. After introducing the KiwiSDR, an implementation of a GNURadio websocket client for the KiwiSDR. As an example on how to use the GNURadio KiwiSDR client, the coherent combination of KiwiSDR IQ streams, and decoders implemented in GNURadio for digital HF modes using the KiwiSDR client are shown.

1 Introduction

The KiwiSDR [1] was developed by John Seamons ZL/KF6VO and by now >300 of these SDRs are available on the internet [2]. In this contribution, a GNURadio websocket client for the KiwiSDR [3] is presented, along with some applications [4].

2 Coherent combination of KiwiSDR IQ streams

The maximum sampling rate for IQ data streams available from KiwiSDRs is either 12 kHz or 20.25 kHz. In order to aqnalyze signals with wider bandwidth, a method was developed which allows to coherently combine up to 6 IQ data streams from a single KiwiSDR [3]. This method uses precise GNSS-derived timestamps to align samples from the same KiwiSDR. Remaining phase offsets between the IQ data streams are estimated and corrected for, see Figure 1.
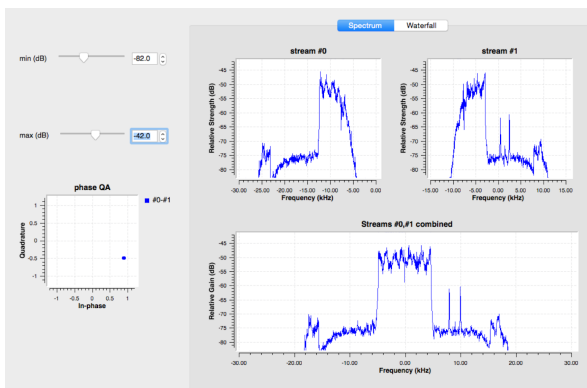

Figure 1: Coherent combination of two KiwiSDR IQ data streams for the case where the boundary between the streams is centered on a DRM signal.

3 Decoding digital modes on HF using GNURadio

A GNURadio OOT module is being developed which allows to concisely specify the physical layer characteristics of a given phase-modulated digital mode on HF in python [5], where preamble cross-correlation, doppler estimation and adaptive filtering are taken care of the framework. As an example the demodulation of a STANAG 4285 signal is shown in Figure 2.
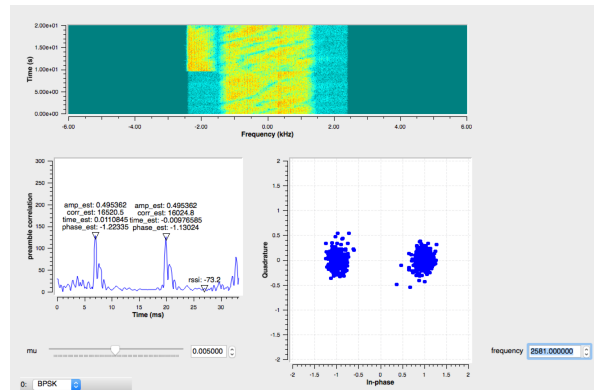

Figure 2: STANAG 4285 signal demodulation using a KiwiSDR IQ data stream. The constellation diagram shows symbols after adaptive filtering and after descrambling.

4 TDoA with KiwiSDR

The IQ data streams from KiwiSDRs contain precise GNSS-derived time stamps. Using this absolute time reference, time difference of arrival (TDoA) methods can be explored. Currently the code for the KiwiSDR TDoA analyis is written in Octave, see [6], which is used by the KiwiSDR TDoA extension written by John Seamons.

Figure 3 shows cross correlations between a LORAN signal received by two KiwiSDRs, and Fig. 4 shows the TDoA map obtained by using the cross correlations from three KiwiSDRs.
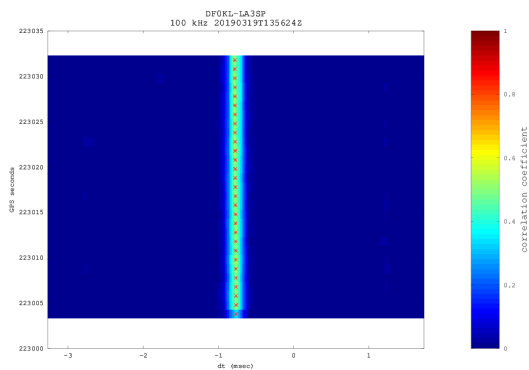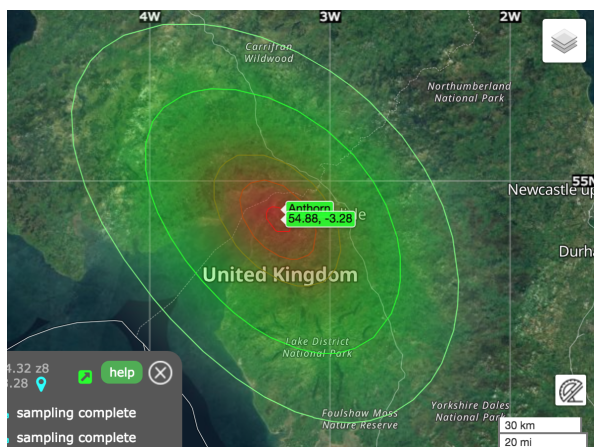

Figure 3: Cross correlations between two KiwiSDRs (LORAN).

Figure 4: TDoA map for the LORAN signal from Anthorn, obtained using data from three KiwiSDRs.

References

[1] *KiwiSDR* at http://kiwisdr.com

[2] *Map of available KiwiSDRs* at http://rx.linkfanel.net/

[3] *gr-kiwisdr* at https://github.com/hcab14/gr-kiwisdr

[4] *Singal Analysis and Monitoring blog* at https://hcab14.blogspot.com/

[5] *gr-digitalhf* at https://github.com/hcab14/gr-digitalhf

[6] *TDoA* at https://github.com/hcab14/TDoA