Radio Datasets for radioelectric spectrum analysis in Colombian Scenarios using GNU radio into the FIT/CorteXlab

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We investigate the use of GNU Radio as a tool to create radiofrequency datasets that will be used for the exploration of machine learning analysis methods. These methods are oriented toward increase the performance of radio spectrum management procedures deployed by the Radio Spectrum Authority in Colombia (ANE).

Keywords: CorteXlab, Machine Learnig, GNU Radio

1 Introduction

Machine Learning applied to radio spectrum analysis can increase our ability to represent, handle and automate radio data tasks [1].In this purpose, the Security and Communications research group (GISSIC) at Military University, explore several alternatives to use Machine Learning techniques into the management of radio Spectrum in Colombia through a study funded by the Spectrum Authority in Colombia (ANE). In order to compare the performance of Machine Learning models and algorithms, it is crucial to have open datasets [2].

The frequency bands included in this work are:: Very High-Frequency in a range from 88 MHz to 108 MHz and 138 MHz to 174 MHz; Ultra High Frequency in the range from 440 MHz to 470 MHz.

We explain the design of the spectrum scenarios using the CorteXlab to generate and record I/Q signals. We use real signals recorded in Colombia to re-transmit it into the CorteXlab in a frequency range from 400 MHz to 4.4 GHz.We present the use of GNU radio as a useful tool for radio datasets generation.GNU radio was used to record signals and for the design of the radio spectrum scenarios into the CorteXlab.

2 Experimental setup

Fig.1 show the radio spectrum for Very High-Frequency band in a range from 88 MHz to 108 MHz measured in Bogota city.This range of frequency is used in Colombia for FM broadcasting.The proposal of the experiment was emulate this radio spectrum conditions of this into the CorteXlab.

GNU Radio was used to record each of the FM radio stations, using a USRP radio. The GNU GNURadio Companion flow graph for acquiring and recording the signals is shown at Fig.2. The recorded files were uploaded to CorteXlab and used to build the spectrum scenario.

Fig.3 shows the disposition of nodes at CorteXlab. The node 33 works as the receiver and all the other nodes are transmitters of FM broadcasting. In a script file, the frequency and the gain for each transmitter are defined by following the rules and procedures of the CorteXlab.
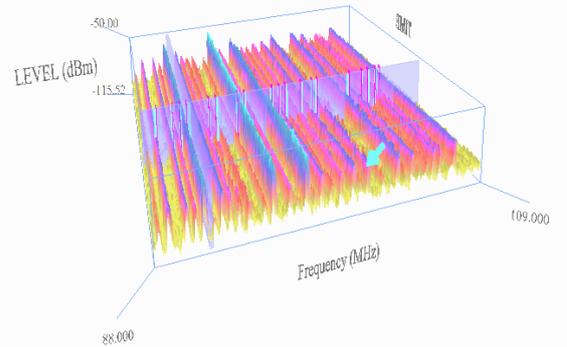
Figure 1: FM Spectrum broadcast in Bogota City.
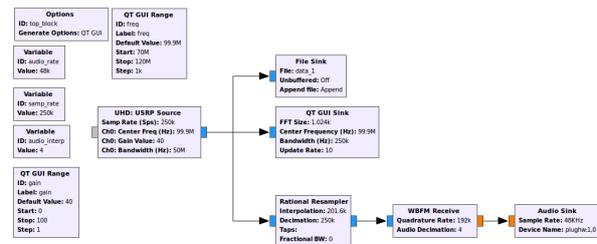
Figure 2: GNURadio Companion flow graph for acquiring and recording data.
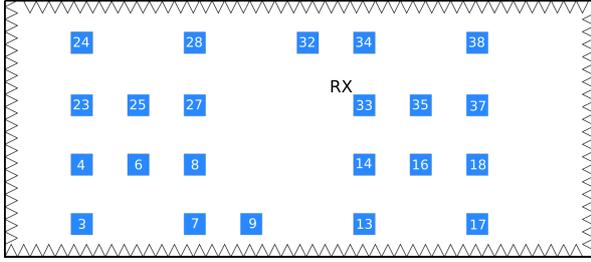
Figure 3: Disposition of nodes at CorteXlab.

A SCP client was used for transferring files to the testbed. Fig.4. The scenario parameters were defined in the *scenario.yaml* file. The results were downloaded for local analysis.
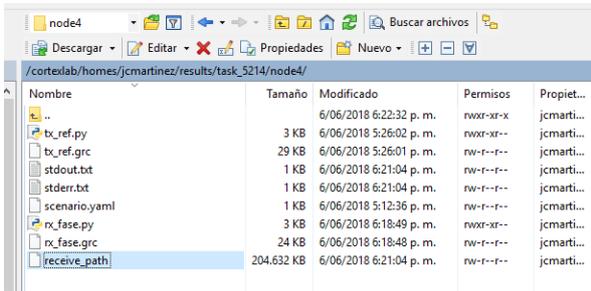
Figure 4: Disposition of nodes at CorteXlab.

Figure 6: Radio spectrum local reconstruction.
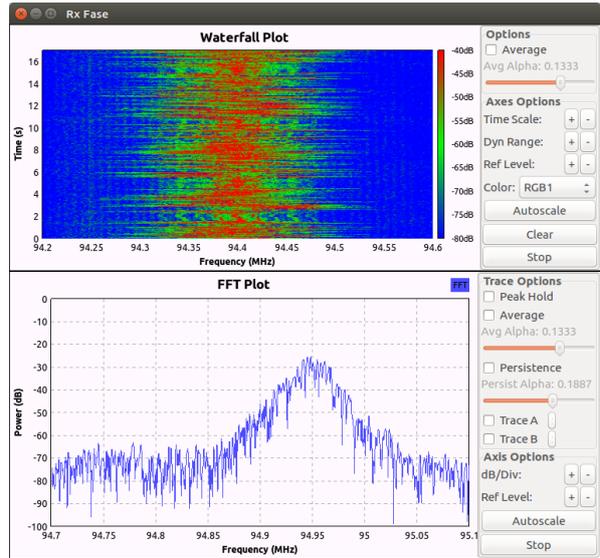
Figure 7: Radio spectrum local reconstruction.
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3 Results

After runnig the task at CorteXlab, we obtained a data file with the I/Q samples. The Fig.5 shows the code for conversion of data file *receive.dat*, obtained from CorteXlab to vectors I and Q in Matlab. The local reconstruction of the file obtained form CorteXlab is shown in Fig.7.

```
fileID = fopen('receive_path','r');
skip = 4;
I = fread(fileID,'float', skip);
fclose(fileID);

fileID = fopen('receive_path','r');
S = fread(fileID,1,'float');
skip = 4;
Q = fread(fileID,'float', skip);
fclose(fileID);
```

Figure 5: Matlab I/Q code conversion for data files.

4 Conclusion

We have demonstrated the usefulness of the CortexLab to emulate the real scenario of radio spectrum transmitting and recording spectrum signals pre-recorded in Colombia into the radio controlled environment. This method allows obtaining I/Q data file to build a dataset of spectrum radio signals for different frequency bands.

By using the methodology, it is possible to record data files that are useful to build datasets of radio spectrum required for the Machine Learning study.

References

[1] T. J. OShea and N. West, *Radio Machine Learning Dataset Generation with GNU Radio*, Proc. GNU Radio Conf (2016)

[2] O'Shea, Tim and Hoydis, Jakob, *An Introduction to Machine Learning Communications Systems*, (2017)