Software Defined Radio: FM Receiver with GNU Radio and RTL-SDR

Introduction

Software defined radios (SDR) are rapidly replacing hardware-based radios with flexible, inexpensive, and powerful radio systems. In this project, a simple radio frequency (RF) hardware component, the RTL-SDR dongle, is used to gather raw FM radio samples and input them into a computer. Blocks GNU Radio Companion then process the raw FM radio data and output audio to the computer audio card.

This project presents a simple method for learning about and designing an SDR. It provides and introduction to GNU Radio, which is powerful tool for research, hobbyist, and commercial communication designs.

Design

Tools

RTL-SDR:

The RTL-SDR is designed to receive radio frequencies between 500kHz and 1.7GHz. It can be attached to antennas of various lengths, and provides raw RF data to any computer via a USB port.

GNU Radio Companion (GRC):

GNU Radio is an open source program designed for radio and prototyping and design on Linux/Unix computers. GNU Radio can be run from a terminal. However, GNU Radio Companion (GRC) provides a GUI for block-design similar to MathWorks’ Simulink.

GRC is simple to learn, but also allows advanced communication and signal processing designers to create their own blocks using Python. GNU Radio also is complemented with an array of git projects and libraries available to everyone!

GNU Radio Companion Example:
GRC Blocks for Signal Processing

The following blocks were used in GRC to receive and listen to FM Radio:

Options: WX GUI

Variable: sample rate

RTL-SDR Source (demodulation)
Complete SDR

The RTL-SDR radio frequency receiver combined with GNU Radio Companion’s signal processing blocks provided a crisp audio output and an array of options additional options for learning about software defined radios.