Software Defined Radio Approach to Satellite Television Reception

Supervisors: Professor Branka Vucetic and Dr. Zhendong (Kyle) Zhou

Number of students: 2

Software Defined Radio (SDR) is a wireless communication system that can potentially tune to any frequency band and transmit/receive any modulation across a large frequency spectrum. Compared to a traditional wireless system, an SDR system, by moving most of signal processing from hardware to software, has a high level of flexibility and can be configured to a wide range of wireless applications with ease. Ideally, an SDR platform is a universal device, which can be configured to be any wireless device, such as a TV receiver, a mobile phone, a GPS navigator, an access point and so on, by simply downloading appropriate software.

In this project, we implement a satellite television receiver using an SDR platform consisting of Universal Software Radio Peripheral (USRP) and GnuRadio. Specifically, we will design and develop open source software modules in compliance with Digital Video Broadcast – Satellite (DVB-S/S2) standard, which is used in Australia and worldwide. This involves writing C++ and/or Python codes for a variety of digital signal processing modules, including demodulator, error correction decoder, synchronization, MPEG demultiplexing, etc.

The students participating in this project should have

- Proficiency in any one programming language
- Good understanding of digital signal processing in communication systems
- Ability to work in a team
Multiple-input multiple-output (MIMO) systems have a larger capacity than conventional single antenna systems. MIMO techniques have been adopted in various wireless communication standards, such as 3G, LTE, WiMAX, WiFi, etc, in order to improve coverage, error performance and throughput.

Modern wireless devices require much greater flexibility than traditional systems. They will be able to adaptively switch their operating frequencies to match the channel conditions, modify their bandwidths, and accommodate various modulation formats, coding schemes and multiplexing parameters. Software defined radio (SDR) presents an ideal solution to this flexibility requirement, by implementing most of the functionalities in software.

In this project, the Gnuradio software framework and Universal Software Radio Peripheral (USRP) hardware platform will be used. A wireless transmission system with multiple antennas at one or both ends of the communication link will be developed based on cutting edge MIMO techniques, such as space-time coding, diversity combining, etc.

This work mainly involves writing programming codes with C++ and/or Python using the Gnuradio framework. A variety of wireless communication modules will be implemented in open source software, which include modulation/demodulation, synchronization, channel estimation, multiplexing, etc.

The students participating in this project should have

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- Good understanding of digital signal processing in communication systems
- Ability to work in a team