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Digital Signal Processing in Radio Astronomy

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Code

 kbandura	Update index.md	1e68e36 · 2 years ago	
 .vscode	typos and glaring erros and ...	7 years ago	
 Delete	lecture update	6 years ago	
 _layouts	Update default.html	4 years ago	
 archive	updates and add LNA assem...	7 years ago	
 assets/css	updated heirrachy moved to ...	8 years ago	
 gbt drift	gbt drift	8 years ago	
 grc-flowgraphs	added demo using lime spec...	6 years ago	
 labs	Update README.md	6 years ago	
 lectures	Update index.md	2 years ago	
 linux	Update README.md	6 years ago	
 python	Merge pull request #15 from...	8 years ago	
 resources	Update README.md	8 years ago	
 .gitattributes	pdfs	8 years ago	
 README.md	Update README.md	4 years ago	
 _config.yml	update .yml	8 years ago	

 README

NOTE: A MORE ACTIVELY UPDATED WEBSITE CAN BE FOUND HERE:

<https://wvurail.org/dspira-lessons/>

DSP in Radio Astronomy

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Introduction

Digital Signal Processing in Radio Astronomy (DSPIRA) is an NSF Research Experiences for Teachers (RET) in Engineering and Computer Science Site at the West Virginia University Lane Department of Computer Science and Engineering. The Principal Investigators are Professors Natalia Schmid and Kevin Bandura. The GBO coordinator is Richard Prestage

Aims of this program:

1. Prepare teachers to implement DSP projects with their students, exposing them to exciting STEM career opportunities;
2. Inspire high school students to pursue careers in STEM disciplines;
3. Broaden the reach of the DSP activities developed through DSPIRA, and
4. Develop the communication / pedagogical skills of the teachers, project staff, graduate and undergraduate students.

Software Defined Radio

A software defined radio (SDR) is a "Radio in which some or all of the physical layer functions are software defined." A radio is any kind of device that transmits and/or receives signals wirelessly in the radio frequency (RF) spectrum above 3 kHz. Traditional radio devices are defined by their hardware and are typically only usable in a specific frequency band and for a particular type of modulation. SDRs, on the other hand, perform most of the complex signal processing needed for modern communications systems at baseband, using digital signal processing (DSP). Analog hardware is then used to translate between a (complex-valued) baseband signal and its corresponding (real-valued) bandpass signal in a frequency band that is suitable for wireless transmission and reception. In its purest form, a SDR consists of an antenna and an analog-to-digital converter for the receiving part and a digital-to-analog converter connected to a power amplifier and an antenna for the transmitting part. All the filtering and signal processing then takes place in the digital domain that can be more precisely controlled in an economic fashion than is possible for traditional analog signal processing. In modern practice, DSP is used for frequencies up to several tens or a few hundreds of MHz and analog hardware is used for frequencies of several hundreds of MHz and beyond. Often the device that translates the digital baseband signal to the analog bandpass signal is referred to as the SDR and then the device (computer) that generates the digital baseband signal is referred to as the DSP.

The main advantage of an SDR over a traditional radio is that (most of) the radio's operating functions referred to as physical layer processing are implemented through modifiable and upgradable software and firmware on programmable devices such as field programmable gate arrays (FPGA), programmable System on a Chip (SoC), etc. The use of these technologies allows new wireless features and capabilities to be added to an existing radio system without replacing or modifying its hardware.

Modern Radio Astronomy is driven by algorithmic advances. As mentioned above, programmable hardware components makes designing a system robust and highly flexible. FPGAs are especially used in almost all current and upcoming telescopes. Programming an FPGA is a skill in itself but one of the most used tools in FPGA development involves coding in a fashion similar to the tools we shall work with vis-a-vis flowgraphs. The

Releases

No releases published

Packages

No packages published

Contributors 2



PranavSanghavi Pranav Sanghavi



kbandura Kevin Bandura

Languages

● **HTML** 52.3% ● **Jupyter Notebook** 42.9% ● **JavaScript** 4.0% ● **Other** 0.8%