

Using SDR in Multidisciplinary Senior Design Projects at CSUN



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Overview



- Accreditation Requirements for Engineering Programs
- Senior Design at CSUN
- Current Projects
 - UAV Telemetry Link
 - Amateur Radio Transceiver
- Real World Skills
- Using SDR in an Undergraduate Project: The Challenges
- Results
- Future Work

Accreditation Requirements



- Engineering programs are required to demonstrate ABET outcomes including:
 - An ability to design a system to meet desired needs within realistic constraints
 - An ability to function on multidisciplinary teams
 - An ability to communicate effectively
- These are often demonstrated in the context of a culminating experience or senior design project
- Projects utilizing SDR are particularly suitable as multidisciplinary due to the need for background in communications, electronics, signal processing and software

Senior Design at CSUN



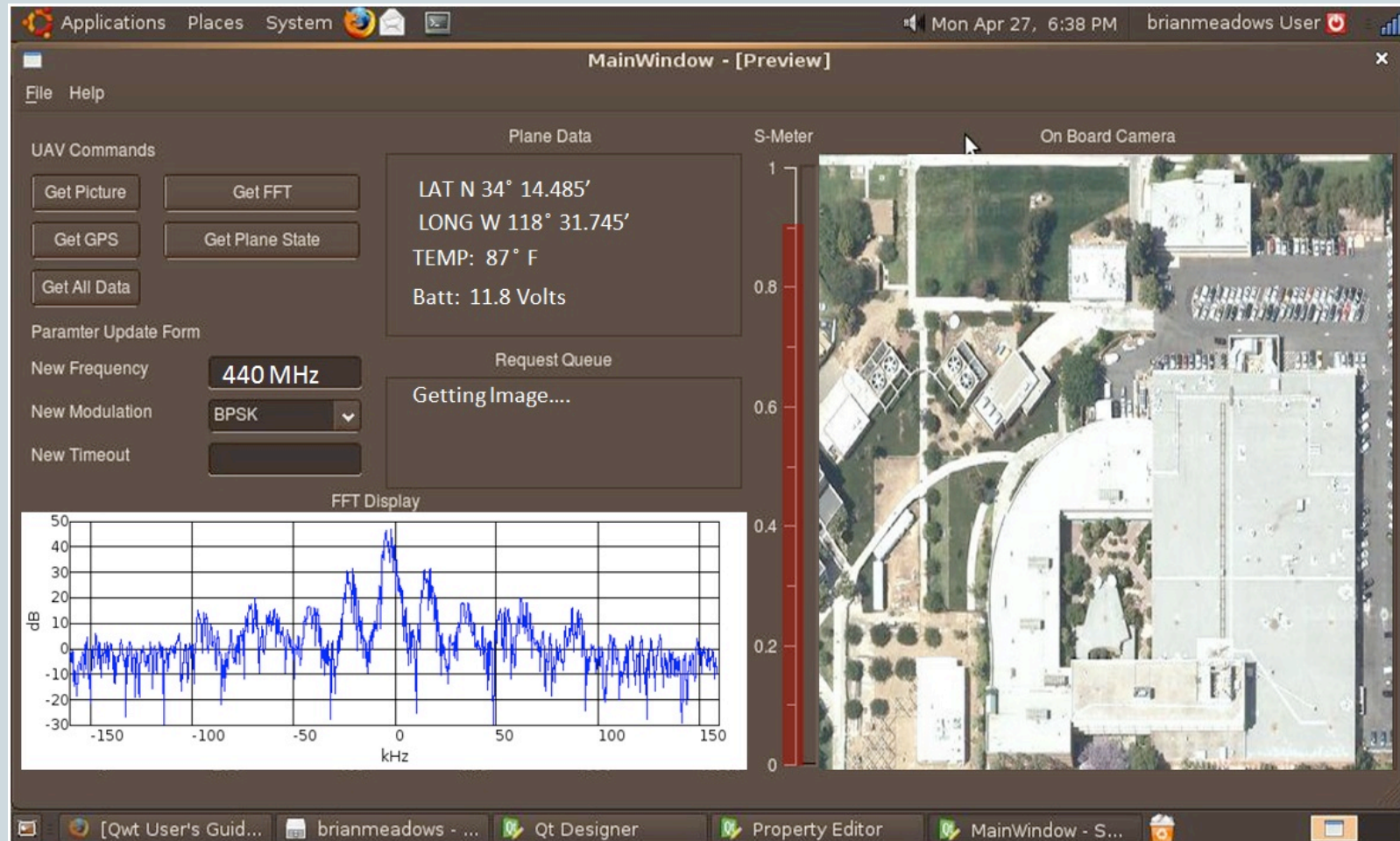
- Undergraduate Students are assigned:
 - An individual design project, and
 - A group project
- One year to complete both projects
- Funding from Edwards Air Force Base to support research/projects in SDR
 - Purchase equipment
 - Support faculty time
- Spring 2009: a group of 12 students were selected to work on group projects in SDR

Current Project: UAV Telemetry Link



- Air – ground UHF link for GPS position, images, battery voltage, aircraft temperature, and link spectrum, as seen from the aircraft.
- Uses SDR on both ends.
- Frequency and mode are agile.
- Aircraft has a “phone home” mode to re-establish communications if link is lost.
- Link and telemetry controlled by commands from ground personnel
- USRP / GNU Radio / Python

Current Project: UAV Telemetry Link

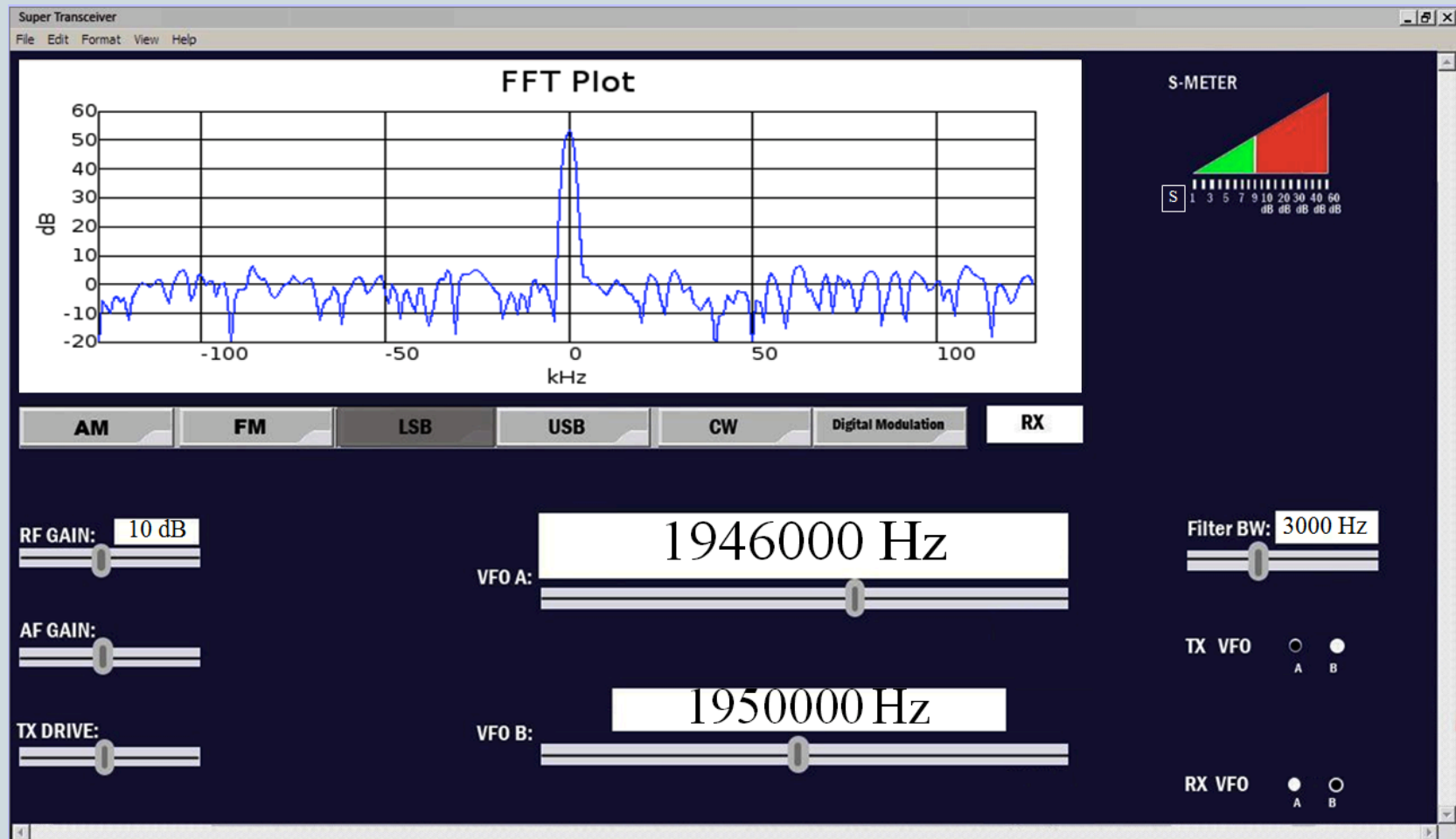


Current Project: Amateur Radio Transceiver



- All-mode (AM, SSB, CW, and FM) transceiver for HF Radio Amateur bands 1.8 to 30 MHz
- Contains features and displays normally found in high end “hardware only” models
- Display and function familiar to most radio amateurs
- Uses SDR for all signal processing
- Hardware limited to receive pre-amp and 100W. transmitter amplifier (provided by faculty)
- USRP / GNU Radio Companion / Python

Current Project: Amateur Radio Transceiver



Real World Skills



- Project was run emulating real-world development environment.
- Faculty acted as “customer”
- One student from each group was project manager
- Students given requirements and had to write specifications and manage time line
- Students required to give weekly oral status reports and documentation.
- Students responsible for interim and final presentations to industry

Using SDR in an Undergraduate Project: The Challenges



- **Background:**

- Both Electrical and Computer Engineering students in each group
- Some students had basic undergraduate communications courses
- Computer engineering students had more extensive software experience
- Instructors selected GNU Radio/ USRP for system development/implementation
- Students had NO background in SDR

Using SDR in an Undergraduate Project: The Challenges (continued)



- **Preparation**

- Fall 2008/Winter 2009: Weekly meetings with students to introduce SDR, GNU Radio, USRP

- **Challenges**

- No experience with Python
- No background in “real” communications systems
- Considerable faculty time required
- Students have no background in SDR
- No Ph.D. students to work with undergraduates
- No established SDR program
- Limitations of GNU Radio Companion

Results



- May 2009: Students presented the results of the first semester of work to a group of 20 members of industry
- Both groups are on track to complete their projects in December 2009 and present their final reports to members of industry
- Projects can now serve as foundation for future SDR projects
- Groundwork for future SDR projects has been laid
- Students have shown excellent improvement in technical and communications skills

Summary / Future Work



- **Fall 2009:** A new group of four students was added to upgrade the UAV link
 - This group will also provide continuity when the other group graduates
 - Include target recognition and implementation of entire SDR system on FPGA platform
- **Conclusions:**
 - Projects using SDR provide an excellent platform for multidisciplinary projects including communications, electronics, signal processing and software.
 - Undergraduates without background in SDR can successfully complete SDR based projects
 - Students are motivated by learning about this emerging technology