Weber State University

Master of Science in Computer Engineering

Academic Plan and Project Proposal

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**Supervisory Committee**

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Member: E-mail:

Member: E-mail:

**Academic Plan**

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| --- | --- | --- | --- | --- |
| Semester | Year | Course No. | Credits | Course Name |
| Fall | 2016 | ECE 3210 | 4 | Signals and Systems |
| Spring | 2017 | ECE 6210 | 3 | Digital Signal Processing |
| Fall | 2017 | CS 6610 | 3 | Computer Architecture |
| Fall | 2017 | CS 6840 | 3 | Formal System Design |
| Spring | 2018 | CS 6420 | 3 | Advanced Algorithms |
| Spring | 2018 | ECE 6410 | 3 | Communication Circuits and Systems |
| Summer | 2018 | SLCC EE 2280  (Substitue for ECE 3110) | 4 | Microelectronics I |
| Fall | 2018 | ECE 3610 | 4 | Digital Systems |
| Fall | 2018 | ECE 6420 | 3 | Digital Communication |
| Spring | 2019 | EE 6010 | 3 | Design Project I |
| Spring | 2019 | CS 6850 | 3 | Parallel Programming and Architecture |
| Fall | 2019 | ECE 6110 | 3 | Digital VLSI |
| Fall | 2019 | EE 6010 | 3 | Design Project |

**Project Proposal**

Project Title: A Comparative Analysis of GPU vs CPU Digital Signal Encoding and Decoding

Purpose

*The process of encoding and decoding digital data for transmition through a Software Defined Radio system is an extremely hardware intensive process. In many cases FPGA are specially configured for this process as a flexible and efficient process; however, their price can outweight their benefit in many situations. As an alternative, the data can be encoded and decoded in a General CPU, but with the amount of computations required, a CPU can be overloaded quickly. An even better alternative is to utilize a GPU which has much potential due to its design for parallel processing. The goal of this project is to determine just how effective a GPU is compared to a CPU by analyzing the computational load, throughput, and power consumption.*

Approach

*The initial steps of the project will be to generate a model using Matlab’s Simulink to provide a basis for comparison and theoretical models and limits for a system. These models will provide valuable insight into theoretical estimates, and provide simulation data that can be fed through the other software system to provide exact data comparisons at various points in the system for debugging and evaluation. Once the MATLAB simulations have been completed, the next step is to utilize the GNU Software Defined Radio to implement a real implementation on hardware, and evaluate the system outside of simulation. The open source modules that are provide by the GNU Software Defined Radio system provide a realistic model. With theoretical simulations and realistic models, the final step is to generate C++ code to perform the digital encoding and decoding on the CPU and the GPU can capture the results for a detailed comparison and analysis. One of the major points to analyze will be the cutoff point where GPU’s become more effective than CPU’s, i.e. when the CPU becomes overloaded, and unable to process data at rate. This will be accomplished by utilizing multiple radios and data streams to push the system to its limits.*

Research

*Multiple resources exist for integrating the various hardware components. As the RTL-SDR and Hack One RF radios are both open source there are multiple examples and open source software that can be utilized (*[*https://greatscottgadgets.com/sdr/1/*](https://greatscottgadgets.com/sdr/1/) *and* [*https://www.rtl-sdr.com/tag/v3/*](https://www.rtl-sdr.com/tag/v3/)*). The Nvidia GPU processors will be programmed using CUDA, and there are various papers that have been written and developed using GPU programming techniques. Another paper describes a framework for utilizing multiple radios to develop a multi radio framework that can provide wide band scanning and allow for parallel searching for a specific signal. This site contains multiple resources for using the GNU Radio (*[*https://www.gnuradio.org*](https://www.gnuradio.org)*). Aside from the broad base of resources, I personally have worked for multiple years in the field of RF Development and system design. I will be able to draw upon that experience, and the expertise of personal at L3 Technologies if needed.*

Criteria

*The Criteria for evaluation can be spread evenly between the following list of tasks:*

1. *MATLAB simulations of* 
   1. *AM*
   2. *FM*
   3. *BPSK*
   4. *QPSK*
2. *GNU Radio Application of*
   1. *AM*
   2. *FM*
   3. *BPSK*
   4. *QPSK*
3. *CPU based Radio Applications of* 
   1. *AM*
   2. *FM*
   3. *BPSK*
   4. *QPSK*
4. *GPU based Radio Applications*
   1. *AM*
   2. *FM*
   3. *BPSK*
   4. *QPSK*
5. *Evaluate the different applications based on the following Criteria*
   1. *Power Utilization*
   2. *Throughput*
   3. *Processor vs GPU utilization*
6. *Multi-Radio evaluation of parallel RF signals in Real Time to demo the effectiveness.*

**Committee Signatures** *(sign only after the project is approved by the faculty)*

Chair Date   
*Type Chairman’s Name Here*.

Member Date   
*Type First Committee Member’s Name Here*.

Member Date   
*Type Second Committee Member’s Name Here*.