Saad Mahboob

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Education

- **Simon Fraser University** — Burnaby, Canada
  PhD in Engineering Science; (Dissertation title: Aspects of 5G systems) — *Aug. 2011 – Dec. 2017*
- **Simon Fraser University** — Burnaby, Canada
  Master (MASc) in Engineering Science; — *Aug. 2007 – Dec. 2009*

Experience

- **Sierra Wireless Mobile Communication Lab** — Burnaby, Canada
  Research Assistant/ Senior Research Engineer — *Jan 2016 - Present*
  - **Convex Optimization**: Implemented Massive MIMO antenna selection algorithm using the Interior Point Algorithm. Converted an NP-Hard integer programming problem to relaxed linear programming problem.
  - **5G Massive MIMO**: Implemented a novel proof-of-concept design for fibre based distributed massive MIMO. Implemented the 5G algorithms e.g. Sphere decoder, Timing recovery, Signal detection and Signal estimation algorithms on the Virtex-6 FPGA.
  - **5G Scalable Channel Sounder**: Proposed a novel low-cost scalable vector channel sounder for the MIMO communication systems. The system uses the fiber delay lines to separate the radio channels.
- **Microsemi** — Vancouver, Canada
  Product Engineering Intern — *Jan 2018 - Aug 2018*
  - **PCIe-4 Receiver Characterization**: This project involved calibration of the PCIe refclk noise to meet specified required noise level. Afterwards, the project involved Gen4 (16G) jitter test with/without cross-talk.
  - **PCIe-3 Receiver Characterization at 125C**: This project involved characterizing the SERDES IP core on PCIE-3 at 125C. For this project the Tcl scripting was used to automate the test bench. The project involved PVT, frequency sweep and JTOL measurements test.
  - **SAS-4 Transmitter Characterization**: This project involved sweeping pre-emphasis settings to obtain equalizer C1/C3 coefficients in order to compare against specs over PVT conditions.
  - **Product Documentation**: My duties also involved creating the reports in Microsoft Excel, and discuss the recommendations with the management. For this purpose, I extensively used the graphs and heatmaps visualization.
- **Simon Fraser University** — Burnaby, Canada
  Operating Systems - Course Instructor — *Jan 2017 - Dec 2017*
  - : Instructed and helped 85 students to learn advanced course on Operating systems. Introduced concepts such as scheduling and synchronization, multi-programming, memory management, file system, and virtual machines.
  - : Facilitated and maintained creative and positive learning environment.
  - : Prepare and maintain all course-related records including evaluation,attendance records, and submit information as required.

Main Courses

- Special Topics in Computer Architecture and Systems : Machine Learning
- Statistical Signal Processing
- Deep Learning / Machine Learning
- Convex Optimization
- Modern Methods in Applied Statistics
- Software Analysis and Design
- Digital VLSI design

Course Projects

- **Dynamic Race Detection with LLVM Compiler**: In this course project, I implemented a dynamic race detector based on low-level compiler instrumentation. The tool can detect harmful races in C++ programs.
- **GEMM accelerator Design in Vivado HLS**: Used Xilinx's Vivado high-level synthesis (HLS) tool to synthesize the GEMM accelerator and generate Verilog or VHDL code at the register transfer level (RTL). Validated the generated RTL code and compared the results with the reference C model. Explored various architectural alternatives.
- **Quicksort algorithm using Pthreads and CUDA**: Implemented the multi-threaded Quicksort algorithm using the Pthreads. Created a parallel implementation of Quicksort on NVIDIA GPU using CUDA and cuBLAS. Finally, compared the results with the sequential and multi-threaded results on CPU.
- **Dijkstras Algorithm in C++14, GCC**: Dijkstra's algorithm finds a shortest path tree from a single source node, by building a set of nodes that have minimum distance from the source. This algorithm is implemented in C++ and uses GCC as a compiler, CMake to automate the build process and Google Test for unit- testing.
- **Wallace Tree Multiplier in VHDL**: In this project, I created an ASIC design for the Wallace Tree Multipler. Wallace multiplier is an efficient parallel multiplier. In the Wallace tree multiplier, the first step is to form partial product array. In the second step, groups of three adjacent rows each, is collected. Each group of three rows is reduced by using full adders and half adders. I used ModelSim software from the Mentor Graphics for HDL simulation. Cadence Encounter RTL Compiler was used for HDL synthesis, and Cadence SoC Encounter was used for automatic place and route.
- **Robust PCA using Principal Component Pursuit in Python**: PCA is great because you can reduce a data matrix to a lower dimension without losing much information. Although it is widely used, PCA doesnt work well when there are noises in the input data. I implemented this algorithm using the Convex Optimization with CVX.
- **LSTM and GRU for Time-Series Prediction**: Implemented the LSTM and GRU arhitectures in TensorFlow to predict the future stock prices with 94 percent accuracy. This project is developed in Python in the Jupyter notebook.
- **Knapsack Algorithm in MATLAB**: Converted the 0/1 Knapsack problem in to a Mixed Integer Linear Programming (MILP) prob, and solved it using MATLAB Integer Programming Toolbox. Later, I used it to Maximize the capacity in wireless network while minimizing the energy consumption.
- **Comparison of Lasso, Ridge and Elastic Net regression in Python**: Compared the performance of Lasso regression, Ridge regression and Elastic Net on the test data using Python. The goal was to understand the effect of l1 and l2 norm penalty .
- **Dynamic program analyses using LLVM.**: In this project, I implemented a limited form of a technique called "Efficient Path Profiling". Identifying which paths in a program execute most frequently can be an effective tool for identifying regions of a program to optimize and for double checking that a program is behaving as expected. Beyond these more expected uses, it can benefit and drive additional analyses ranging from dataflow analysis to statistical debugging to designing custom hardware.
- **Callgraph Profiler using LLVM**: In this project, I constructed an LLVM tool that can compute and output a weighted dynamic call graph for an execution of an input program. A call graph is a directed graph where the nodes represent the functions within a program. Such call graphs can be helpful for examining the structure of a program, and they are also a crucial first step in many other analyses. They are especially useful for understanding programs with indirect calls or function pointers.

Programming Skills

- **Languages**: Python, CUDA, C++, Java (basic), MATLAB, CMake, Google Test, Vivado HLS
  Technologies: Linux, GCC, LLVM, Tensorflow, Keras, CVX, Git
  Data Science: AWS, Google Cloud, Spark

Certifications

- Certification for NI High-Throughput LabVIEW FPGA
- Certificate Program in University Teaching and Learning
- Deep Learning Specialization - Coursera

Publications

- S. Mahboob, and R.G. Vaughan,"Fiber-Fed distributed antenna system in an FPGA software defined radio for 5G demonstration," IEEE Transactions on Circuits and Systems II: Express Briefs, pp. 1-5, 2019.
- S. Mahboob, and R.G. Vaughan, "Antenna selection in a massive MIMO," IEEE Transactions on Circuits and Systems–II: Express Briefs. (Under Review)

- S. Mahboob, and M. Sharma, "Simplified wideband 5G vector channel-sounder," IEEE Transactions on Circuits and Systems–II: Express Briefs. (Under Review)
- S. Mahboob, S. Stapleton, "Adaptive interference cancellation system for multihop cellular networks," Journal of Selected Areas in Telecommunications (JSAT) 01(01). pages 7-17, 2010.
- S. Mahboob, and S.B. Ram, "Vector channel sounder using fiber delay lines to separate the channels", Proc. IEEE International Symposium on Antennas and Propagation and USNC-URSI National Radio Science Meeting, pp. 1113- 1114, 2017.
- R. Ruby, S. Mahboob, and D.G. Michelson "Optimal configuration of distributed MIMO antennas in underground tunnels", IEEE International Symposium on Antennas and Propagation and USNC-URSI National Radio Science Meeting, pp. 65-66, 2014.
- S. Mahboob, R. Ruby, and Victor C.M. Leung., "Transmit antenna selection for downlink transmission in a massively distributed antennas system using convex optimization", in Proc. IEEE International Conference on Broadband And Wireless Computing, Communication and Applications, pp. 228-233, 2012.
- S. Mahboob, "Adaptive interference cancellation system for a WCDMA repeater," in Proc. IEEE Canadian Conference on Electrical and Computer Engineering (CCECE), pages 1-5, 2010.
- S. Mahboob, "FPGA implementation of digital up/down convertor for WCDMA system," in Proc. IEEE International Conference on Advanced Communication Technology (ICACT), pages 757-760, 2010.
- S. Mahboob, "Adaptive interference cancellation system for multihop WCDMA 3G networks," in Proc. IEEE Vehicular Technology Conference (VTC), pages 1-5, 2010

Presented Posters

- "Antenna Selection in Massively Distributed Antenna Systems for Short Range Vehicular Networking Infrastructure", 4th Annual Workshop on Developing Next Generation Intelligent Vehicular Networks and Applications (DIVA), 2014-Ottawa Canada.
- "A Distributed Channel Sounder for Short Range Vehicular Networks in Urban Microcells", 4th Annual Workshop on Developing Next Generation Intelligent Vehicular Networks and Applications (DIVA), 2014-Ottawa Canada.
- "Distributed Channel Models for Short Range Vehicular Networks in Urban Microcells", 4th Annual Workshop on Developing Next Generation Intelligent Vehicular Networks and Applications (DIVA), 2014-Ottawa Canada.
- "Broadband Wireless Access Fiber-connected Massively Distributed Antennas (BWA-FMDA) for 4G Communication", ICICS/ECE/IEEE Workshop on Future Communications and Multimedia Systems, 2011 - Vancouver Canada