Perrin Silveira

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EDUCATION

California Polytechnic State University   San Luis Obispo, CA

Bachelors of Mathematics   *March 2020*

Senior Project: Deep Neural Networks and Choosing a Character in the Game Defense of the Ancients 2

Relevant Coursework: Calculus Series, Linear Algebra 1 and 2, Differential Equations 1, Linear Analysis 2, Complex Analysis 1 and 2, Combinatorial Math, Theory of Numbers, Graph Theory, Mathematical Software, Discrete Math with Applications 1, Real Analysis 1 and 2, Numerical Analysis 1, Numerical Analysis 2 (Not official, lectures only), Euclidean and Modern Geometries, Abstract Algebra 1 and 2, Topology 1, Senior Project Applied Seminar, Statistical Inference/Management 1, Statistics 1, Statistical Analysis of Time Series, Mathematics Modeling Seminar(3 years), Microcontrollers for Everyone

SKILLS

- **Programming languages in order of usage amount** : C++ , Python, C , Wolfram Language (math -> functional and symbolic manipulation), Matlab Language (math -> inexact fp computation), LaTex (document layout), Go (Golang), Java, Lua, Rust

- **Technologies not in order** Math: Mathematica, Matlab; Design: Solidworks, Inventor, AutoCAD, Inkscape; 3D printing slicers: Slic3R and its many forks, Cura, Ideamaker, Chitubox, HP Build Manager; 3D printing other software: Klipper, KIAUH, Moonraker, Mainsail, Octoprint; Software development misc: Github, Gitlab, Docker, OpenCV, Gazebo, ROS, Mavlink, Mavros, PX4, ArduPilot, QGC, Mission Planner; Comms firmware protocols: SPI, CAN, I2C/SMBUS, SBData; OS for development: Ubuntu, Windows, Debian; Misc that I have used but wouldn't claim any knowledge on: Cmake, GStreamer, L4T

EXPERIENCE

Empirical Systems Aerospace   San Luis Obispo, CA

Additive Manufacturing Engineer   *August 2021 - August 2023*

- **3DP Lead**: Carried on duties as the 3D printing lead from previous temp position, continuously improving my skills, knowledge, and the printers.
  - Created and continuously expanded a 3D printing specific materials database for mechanical properties, thermal properties, expected tolerances. and numbereous cost efficeincy metrics relating to material use case
  - Designed (using Solidworks) and printed numerous unique tools for the 3D printing area, and other areas/diciplines on request
  - Acted as the main point of contact for optimizing part design for 3D printed composite molds
  - Upgraded and maintained FDM, SLA, and MJF printers however possible including Klipperizing, doing toolhead design/replacement, improving cooling solutions, and performing maintenance and troubleshooting typically reserved for manufacturer appointed technicians greatly reducing machine downtime.
  - Took over part postprocessing and became the sole member of the 3D print shop, taking responsibility of all operations from start to finish including precision sanding ensuring perfect fit of parts
  - Submitted numerous continuous improvement requests for technologies that fit the needs of the business, and implemented them when possible
  - Printed over 2000 log entries, for a total number of parts likely in the 10k range
  - Helped and coached around a dozen coworkers in: what printers to buy based on their personal budget and printing needs, their personal tolerance for fiddling with things, what special gcode specific tweaks are needed for their printer, settings tweaks and why they make a difference based on visual feedback and slicer settings, and part design for problems they were having

- **Organic Swarming**: Generated the algorithm and tech stack for leaderless organic fault tolerant drone swarming
  - Developed a Dockerized solution for running multiple isolated simulated PX4 based autopilots along with a Software In The Loop simulator
  - Developed, tested, and created internal whitepaper for distributed messaging system and swarming algorithm for controlling all drones with single groundstation inputs
  - Migrated tech stack over to using PX4 Software In Hardware simulation and revalidated test results
  - Helped troubleshoot migration of container and deployment shcemes onto Nvidia Jetson/Xavier platforms
  - Repurposed lesser used GCS features to be able to control both individual drones and the whole swarm at the same time easing testing risks
  - Went out on flight test and helped analyze issues present in test flights

- **Vision Tracking**: Working off existing Jetson/Xavier streaming system for foundational work in setting up vision tracking and disturbance rejection
  - Used image processing libraries to generate image registration between succesive frames, and worked heavily in rejecting bad registrations
  - Created multiple metrics to track likelyhood of correct image registration, and implemented checks on each metric, and backup conditions forfailure cases

- * Achieved realtime stabilization with respect to a given initial frame
- * Work on integration with already in place streaming system
- * Work on using stereoscopic image streams for image information
- * Work on implementing object trackers into the vision pipeline
- **Firmware Development**: Working on two seperate but related firmware projects for ultra low power needs
  - * Worked on microcontroller selection and decision matricies for ultra low power hydrogen tank onboard management
  - * Selected a microcontroller and associated hardware for the application, and wrote up firmware to wake up at extremely long intervals taking temperature and pressure readings throughout the tanks life, and permanantly storing them for diagnostic use. (funding delayed before integrating CAN, diagnostics, and fill-rate features)
  - * The same microcontroller was selected as the basis for a battery management system, and I took the lead in developing SPI, CAN, and I2C/SMBUS/SBDATA integrations with other ultra low power chips.
  - * Diagramming out control flows, creating proof of concept and functionality tests, creating drivers to execute based on requirements of various other chip specs and customer needs, created higher level systems for efficient use and ease of programming
  - * Spent a large amount of time debugging physical hardware issues with multimeter, oscope, logic analyzer, function generator etc
  - * Spent a large amount of time pouring through datasheets, and dealing with the peculiarities of ultra low power systems like inadequate strength of internal pullup/pulldown resistors and collaboratively troubleshooting with the lead PCB designer for the BMS system
- **Contributions to OpenVSP**: Worked on cleaning up OpenVSP code base, and doing some modernizations
  - * Worked on unifying Angelscript documentation with source C++ code, and generating basic full documentation via Doxygen
  - * Worked on refactoring Angelscript bindings such that the code for each unit is multiple times smaller
  - * Wrote a heavily regex based script for capturing all potential candidates for certain types of functions defined in each file of the source code
  - * Took over work on modernizing Verification and Validation for OpenVSP
  - * Translated the 7KLOC monolithic, hand written, and hardcoded HTML generating script into a series of organized, parallel executable scripts for each individual test
  - * Implemented a system for results caching and fully confiurable runtime scheme of what aspects need regeneration
  - * Conglomerated everything into a markdown file for the full report and all of its various graphs
- **Gitlab Testing and Migration**: Pioneered the switch onto company owned hardware for git solution meeting the need of the rest of the software team and eventually everyone using git
  - * Went through the chosing process for an ITAR compliant git system with the needs of the company in mind, and settled on selfhosting a Gitlab instance.
  - * Did internal testing and test migrations of existing projects into Gitlab
  - * Built up a first set of Gitlab jobs and runners for building and storing the APK for Android groundstation functionality
  - * Coordinated with IT for handling migration to an internal server cluster, and dealt with all of the needed security and keys for live deployment into the software group

Empirical Systems Aerospace
San Luis Obispo, CA
Temp
April 2021 - August 2021

- **3DP Lead**: Took on the responsibility for running the 3D printing department
  - * Established documentation system for 3D printing records including standardized file naming conventions
  - * Created custom cost tracking implementation for 3D print log
  - * Established a set of working settings for over a dozen different polymers through research and empirical testing
  - * Created process and tolerance guides for tolerance critical applications.
  - * Provided engineering suggestions and/or alterations to Solidworks parts for optimal printing and material choice coinciding with end use
  - * Performing inventory management and handling logistics

California Polytechnic State University
San Luis Obispo, CA
Student
September 2015 - March 2020

- **Senior Project**: Created, trained, and sourced data for a DNN to predict character choices of professional Dota 2 players
  - * Created a system to pick out, format, store, and create tokenized vectors from data from Opendota.com
  - * Created both a bag-of-words neural network, and a skip-gram version of the neural network for future comparison
  - * Trained the neural network on a limited data set for testing other features
  - * Created a vector embedding for analysis of semantic similarity and vector reasoning
  - * Created a visual for the semantic similarity between characters, and using t-sne a map of relative clustering of characters to help comprehend the vector embedding
  - * Learned much more about neural networks and the theory behind them for the formal write-up, making sure I could compute a neural network out by hand instead of using pre-built codes
- **Mathematical Software**:

* Solved hundreds of complex real-world programming problems while learning the Wolfram Language and Mathematica
  * Learned many of the harsh realities of programming and really began to understand the need for clear, clean, consistent, well organized, readable, and well commented code
- **Mathematical Modeling Seminar**: A class given in preparation for the Mathematical Contest in Modeling
  * Year 1: Created and analyzed a model of ionospheric and ocean reflection of HF radio waves under different atmospheric conditions, and learned how to create a formal paper in LaTex for submission
  * Year 2: Created and analyzed a model of the growth rates of the GoT dragons based upon real-world biological laws and the environmental conditions in Westeros including its extreme seasons, and created a formal paper for submission in LaTex
  * Year 3: Created and analyzed a model predicting vital fish migrations around Scotland under global warming scenarios examining economic impact for small fisheries and creating recommendations. Mentored two new students and established a successful team environment.
- **Senior Project Applied Seminar**: A class targeted as a deep dive into mathematical modeling and usage of applied mathematics
  * Adapted and analyzed a model of traffic flow patterns with regard to the percentage of autonomous vehicles on the road to human operated vehicles under realistic local traffic conditions.
  * Wrote up a full technical report, slideshow presentation, and poster for public and faculty review.

California Polytechnic State University — San Luis Obispo, CA
Student Researcher — *April 2019 - August 2019*

- **Climate Research Group (Around 350-450 hrs)**: Dissected the papers and recreated full implementations of the climate models of Saltzman and Verbitsky in their 1992 and 1993 papers, and performed many different tasks in model validation and exploring the properties of the model itself. After implementation, specifically examined phase locking in the oscillations of the system at different levels of forcing due to solar radiation and different oscillation rates. Presented work product and poster to the public and faculty. Contact: Dr. Charles David 'Dave' Camp camp@calpoly.edu

Eagle Robotics FIRST Team 1388 — Arroyo Grande, CA
Student -> Mentor — *October 2011 - Present*

- **Student (Around 170-180 hrs a year)**: Learned to program, fabricate, and ultimately design robots to meet various specifications of the competition
  * Learned how to behave in a professional environment and how to present ideas to other team members and the public at events
  * Learned how to work safely and efficiently to construct parts to specification in a machine shop
  * Learned how to design and operate different design softwares (Autodesk Inventor and AutoCAD) independently during the summer so that I could take on a lead design role my senior year
- **Mentor (Around 150-170 hrs a year until 2022 with around 400 hrs a year after)**: Taught and assisted students in the process of designing and building a robot
  * Learned a new design software (Solidworks) so that I could continue to teach the students and help them with the problems they encountered in the design process (switched in 2015)
  * Learned, supervised, and helped instruct students and other mentors on the operation of various tools in the machine shop including milling, lathe operation, tig welding, CNC rouer setup, selection of speeds and feeds, and CAM
  * Created an independent and mathematical implementation of swerve drive, a more complicated drivetrain style, in Mathematica and implemented the model constructed in the Java framework the robot is controlled with. Became much more familiar working in an object-oriented language.
  * Independently developed the skills and knowledge base to be able to successfully 3D print a large variety of 3D models so that as a team we could both continue teaching students how to operate a 3D printer, and integrate 3D printing into our design process. Previously, 3D printing had been a student-led project of which all students suddenly left the team, and our printer only got used by our public relations subteam as a means to advertise due to reliability issues.
  * Currently spearheading the project for the robotics team to design, build, and program a long range remote control robotic arm for the Grover Beach Police Department's EOD robot

SIDE PROJECTS / ACTIVITIES

- **Independent Manufacturing**: I have had numerous side projects involving laser cutting, 3D printing and 3D printer construction, composites molding and layup, 2D and 3D design, image manipulation, sewing, tool sharpening, and more. I enjoy finding a problem, and using hardware or software tools to craft a solution
- **Dota 2 Modding**: Created a script that generates a complete text file organizing key-value pairs that are randomized within certain bounds for a Dota 2 custom game mode. Learning Lua scripting using Dota specific documentation and other users GitHub projects to create multiple of my own custom game modes.
- **Marching Band Volunteer Instructor**: Mentored and helped train students in proper marching form, and strength/endurance building. Also served as the main equipment transporter and sound tech during practices and performances. Two years of 80 hours for band camp, and 10 hrs a week for the following 3 months or so
- **Volunteer Fireworks Salesman**: Served 3+ years as a fireworks salesman for the local band and the local robotics team on years they are selected to have a booth. Roughly 6-6.5 hours every day for a week once a year helping customers find the perfect composition of fireworks to fit their needs and their budget.