Perrin Silveira

perrin.silveira@pacbell.net | 805-305-1574 | Github: leparrain777
527 Orchard Ave, Arroyo Grande, CA

Education

California Polytechnic State University San Luis Obispo, CA
Bachelors in Mathematics *Expected 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, Mathematical Software, Discrete Math with Applications 1, Real Analysis 1, Numerical Analysis 1, Numerical Analysis 2 (Not official, lectures only), Euclidean and Modern Geometries, Abstract Algebra 1 and 2, Statistical Inference/Management 1, Statistics 1, Mathematics Modeling Seminar(2 years), Microcontrollers for Everyone

Skills

- **Languages**: Wolfram Language, Python, C++, Matlab Language(Expected), LaTex
- **Technologies**: Mathematica, Matlab(Expected), Inventor, Solidworks, AutoCAD, Github

Experience

California Polytechnic State University San Luis Obispo, CA
Student *September 2015 - Present*

- **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 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 theory behind them for the formal write-up, making sure I could compute a neural network out by hand instead of using pre-built code
- **Mathematical Software**:
  - Solved hundreds of complex real world programming problems while learning the Wolfram Language and Mathematica (can be provided upon request)
  - 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 created 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

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

- **Climate Research Group**: Ongoing: I am tasked with recreating the climate model of Saltzman and Verbitsky in their 1992 and 1993 papers, and performing many different tasks in model validation and exploring the properties of the model itself. Attached at the end is an extremely brief summary of the work to be done and the considerations going into our research. Contact: Dr. Charles David 'Dave' Camp camp@calpoly.edu

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

- **Student**: 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 how to design optimally 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**: Taught and assisted students in the process of designing and building a robot
  - Learned a new design software (Solidworks) so that I could help the students with the problems they encountered in the design process
  - Supervised and helped instruct students and other mentors on the operation of various tools in the machine shop including milling, lathe operation, and tig welding
  - Current/Intermittent: Created an independent and mathematical implementation of swerve drive, a more complicated drive terrain style, and (helped / am helping) to port the math into the Java framework the robot is controlled with.

Side Projects / Activities

- **Continuation of Senior Project**: My current plan is to expand my project to run as a website that automatically fetches data, trains, and displays the output of the neural network and vector embeddings. Also included would be a small analytic engine using the properties of the vector embedding for computations on character vectors.
- **An actually useful music visualizer**: Incomplete: Creation of a music visualizer that uses mode decomposition to wrap the approximate amplitude of the notes being played around a circle in such a way that the different octaves of the same note will stack additively where each octave layer will have a different color. This is so a musician could easily pull out the notes being played in a song along with the octave without having to consult a spectrogram and a chart of note frequencies.
- **Dota 2 Modding**: Created a script that generates a complete file of key value pairs that are randomized withing certain bounds for a Dota 2 custom game mode. Ongoing: Converting the script to Lua to run in the game engine instead of having to reupload the mod for every run of the script
- **Marching Band Volunteer Instructor**: Mentored and helped train students in proper marching form, and strength and endurance building. Also served as the main equipment transporter and sound tech during practices and performances.

Response of paleoclimate models to external forcing

Key Questions:

1. Scientific
   (a) "100 kyr problem":
      i. What is the underlying cause of the slow glacial cycles in late Pleistocene?
      ii. Cause of MPT?
   (b) Are the cycles predictable?
      i. Are full melts triggered by fast forcing or based on internal dynamics?
      ii. What is the role of fast forcing: obliquity / precession in cycle timing?
      iii. Role of eccentricity? Envelope of precession?
      iv. Synchronicity?
   (c) "41 kyr problem":
      i. Why does response emphasize obliquity over precession time scales?
      ii. Linear response vs non-linear filter?
      iii. What is the appropriate temporal scope of the astronomical forcing: seasonal averaging v solstice
      iv. Insolation: latitudinal gradient vs high-latitude amplitude?
2. Modeling
   (a) What is the impact of mathematical model structure?
      i. Role of irreversibility in dynamics? (Smooth vs non-smooth models?)
      ii. Role of asymmetry in limit cycles?
      iii. Preservation / loss of memory of state / synchronicity?
      iv. Are these related?
   (b) Sensitivity to choice of astronomical forcing.
   (c) Model response to quasi-periodic forcing.
   (d) Model response to statistical forcing.
   (e) Combination of both above forcing types.
   (f) Model validation against observed features.

Key new hypothesis:

- Observed cycles caused by non-linear interaction between forcing & internal cycles.
- Timing of warming caused by high insolation.
- Varying impedance caused by internal cycle.
- Gradual growth of impedance **OR** appearance of new source of impedance.

Key concepts in forced dynamical systems

1. Pullback attractors
2. Excitation
3. Phase-locking /synchronization
   - Arnold Tongues
4. Stochastic Resonance
5. Predictability / Chaotic behavior

Features of glacial cycles

1. Timescales of oscillation
   (a) Cross-correlations IMFs vs astronomical forcing
2. Amplitude ratios across time scales
   (a) IMFs: Early 41, Late 100, Late 40, Early & late 20 (kyr)
3. Identification of full and partial melts
4. Timing of full melts
5. Timing of partial melts
6. Asymmetry of cycles
7. Asymmetric memory of state within cycle
8. Synchronicity: loss of memory
9. initial growth of slow cycle

Tasks

1. Analysis tools
   (a) Precession cross-correlation
   (b) ID of melts from ice volume
   (c) Circle statistics for timing of melts
   (d) Asymmetry of cycle measures
   (e) Within-cycle correlations of ice volume
   (f) Clustering of trajectory cross-sections

2. Models
   (a) PP04
      i. Drift runs vs extended fixed param. runs
      ii.
   (b) SM models
      i. Compare anomaly models to full models
      ii. Improve “model switch” analyses (ice volume based)
      iii. Identify “impedance” with examples
   (c) SV models
      i. Implement
      ii. Extended fixed param runs
      iii. Drift
      iv. Anomaly vs full?
      v. Isolate “impedance” to forcing

Key Papers

- Paillard, Quaternary glaciations: from observations to theories. *Quaternary Science Reviews*, 2017
- Tziperman, et. al, Consequences of pacing the Pleistocene 100 kyr ice ages by nonlinear phase locking to Milankovitch forcing. *Paleoceanography*, 21(4), 2006
- B De Saedeleer, M Crucifix, and S Wieczorek. Is the astronomical forcing a reliable and unique pacemaker for climate? A conceptual model study. *Climate Dynamics*, 40(1-2): 273?294, 2013
- M Kominz, G Pisias, Pleistocene Climate; Deterministic or Stochastic, *Science*, 1979
- Mitsui-Aihara, Dynamics between order and chaos in conceptual models of glacial cycles, *Clim. Dyn.*, 2014
- Mitsui-Crucifix-Aihara, Bifurcations and strange nonchaotic attractors in a phase oscillator model of glacial?interglacial cycles, *Physica D*, 2015
- D Palliard, Climate and the orbital parameters of the Earth, *Comp. Ren. Geosci.*, 2010
- D Palliard, Glacial Cycles: Towards a new paradigm, *Rev. Goeohys.*, 2001
- PALEOSENS, Making sense of palaeoclimate sensitivity, Nature, 2012
- Raymo, Unlocking the mysteries of the ice ages, Huybers, Nature, 2008