Spencer Powers

Curriculum Vitae

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he/him/his

Education

2016–2021 **Bachelor of Science in Aerospace Engineering** (GPA: 3.95/4.0)
University of Southern California, Los Angeles.
Minor in Statistics
Expected graduation date: 05/14/2021

Skills

Programming Languages: Python, C++, MATLAB, Java, Mathematica

Tools: Siemens NX, Vim, MS Visual Studio, LaTeX

Research Experience

Neural Computation and Neuromorphic Computing

12/19 – Present **Remote Undergraduate Research Assistant**
The Berry Lab, Princeton Neuroscience Institute, Princeton University, Princeton.
The Berry Lab (PI: Dr. Michael J. Berry II) investigates how thousands of neurons connected in local microcircuits combine to carry out novel and powerful computations in the retina.

- Developed a Python codebase to investigate the fit behavior of an EM-based algorithm for fitting a latent variable model to the activity of a population of spiking neurons
- Investigated neuron population size thresholds for effective unsupervised learning of clusters of population responses from spike train data
- Optimized this custom codebase to run on the PNI computational cluster

05/20 – 08/20 **Student Researcher**
Department of Physics and Astronomy, University of Southern California, Los Angeles.
PHYS 760 (Instructor: Dr. Satish Kumar Thittamaranahalli) is a PhD-level course focused on the development of an original research topic devised by the student.

- Built Python codebase to independently reproduce results of "Memristive nanowires exhibit small-world connectivity" by Pantone et al. from Rain Neuromorphics (2018).
- Extended network topology analysis by estimating the topological dimension of the modeled neuromorphic chip architecture.

Rocket Propulsion

08/19 – Present **Technical Advisor**
The Advanced Spacecraft Propulsion and Energy (ASPEN) Laboratory, University of Southern California, Los Angeles.
Student research group focused on nuclear propulsion and power for spacecraft. Faculty advisors: Dr. Charles Radovich, Dr. Matthew Gilpin

- Interfaced with new lab leads to ensure steady and focused progress on all research projects
- Spearheaded technical recruitment efforts, grew lab from 9 initial members to 31 after first recruitment cycle

05/18 – 08/19 **Co-Founder, Lab Lead**
The Advanced Spacecraft Propulsion and Energy (ASPEN) Laboratory, University of Southern California, Los Angeles.
Student research group focused on nuclear propulsion and power for spacecraft. Faculty advisors: Dr. Charles Radovich, Dr. Paul Giuliano (Departed USC winter 2019), Dr. Matthew Gilpin

- Led development of electromagnetically-coupled computational fluid dynamics (CFD) models of the first Hyperion-1 test article using ANSYS Maxwell and Fluent
- Developed CAD models of the Hyperion-1 test articles for simulation and manufacturing
  - NERVA-type inductively heated metallic core using GN2 as the working fluid
- Presented original research at a conference within the first 7 months of the lab's inception
- Designed the Hyperion-1 test campaign, created master Gantt Chart to guide development
- Stood up engine sizing sheet that was used for preliminary feasibility studies

11/16 – 05/18 **General Engineer**
Liquid Propulsion Laboratory, University of Southern California, Los Angeles.
Graduate-level lab designing, building, and testing bi-propellant liquid rocket engines.

- Led ignition system development for the first successful hot fire of the Blue Steel (GOx/Kerosene) engine

Presentations, Publications, and Research Reports

2020 Samantha Cendro, Trey Cranney, Spencer Powers, Connor Powers, Branden Kretschmer, Diego Ochoa-Cota, Micah Pratt. "Simulation and Experimental Validation of an Inductively Heated Solid-Core Nuclear Thermal Rocket Model." *2020 AIAA Propulsion and Energy Forum*.

2020 Spencer Powers. "Investigating the Topological Dimension of a Novel Manufacturing Method for Neuromorphic Hardware". *Report submitted for PHYS 760 research project.*

2019 Connor Powers, Spencer Powers, Samantha Cendro, Diego Ochoa-Cota, Branden Kretschmer. "Development Campaign for an Additively Manufactured, Inductively Heated Model of a Solid-Core Nuclear Thermal Rocket Engine". *Oral presentation at the 2019 Nuclear and Emerging Technologies for Space (NETS) Conference.*

2019 Spencer Powers, Connor Powers, Trey Cranney, Sam Cendro, Diego Ochoa-Cota, Branden Kretschmer, Kristen Pederson, David Amaral. "Development Campaign of an Additively Manufactured, Inductively Heated Model of a Solid-Core Nuclear Thermal Rocket Engine." *Poster presentation at the 2019 Undergraduate Symposium for Scholarly and Creative Work [Honorable Mention in the Physical Sciences, Math, and Engineering category].*

Honors and Awards

2016 - 2021 Presidential Scholarship
Half-tuition merit scholarship

2016 - 2021 Viterbi Fellow
Highly selective group of incoming students with access to research funding

2016 - 2021 W.V.T. Rusch Undergraduate Engineering Honors Program

2016 Merit Research Scholar
Awards funding for select students to work in faculty labs

Professional Experience

06/19 – 08/19 **Summer Intern**
Department of Army, Washington D.C. (Clearance: **Top Secret**).
- Wrote software to conduct initial research analysis of systems for surveillance satellites
- Evaluated advanced concepts for satellite systems and provided recommendations to focus the efforts of a multi-million dollar R&D portfolio

05/18 – 12/18 **Development Engineering Intern**
ABL Space Systems, Los Angeles.
- Member of small internal team that started ABL's in-house liquid rocket engine development program
- Responsible for the design of an additively manufactured showerhead-type injector for the E2 engine
- Responsible for the design of the first E2 engine gas generator combustion device
- Responsible for the design and manufacturing of primary structure components

Selected Coursework

MATH 447 – **Mathematics of Machine Learning**
PAC learning, VC-dimension and complexity. Linear predictors (regression, perceptron, SVM). Convex learning and gradient descent.

AME 451 – **Linear Control Systems I**
Transform methods, block diagrams; transfer functions; stability; root-locus and frequency domain analysis and design; state space and multiloop systems.

PHYS 760 – **Selected Topics in Computational Physics**
PhD-level summer course focused on developing an original research project relating to artificial intelligence and machine learning under the guidance of the instructor (Dr. Satish Kumar Thittamaranahalli).

AME 490 – **Directed Research (Summer 2019)**
Directed study in nuclear reactor physics and design principles. Advisor: Dr. Satwindar Sadhal.

AME 341a/b – **Mechoptronics Laboratory I and II**
A coordinated laboratory and lecture sequence on aeromechanical instrumentation and device control stressing the symbiotic integration of mechanical, optical and electronic components.

AME 261 – **Basic Flight Mechanics**
Performance of flight vehicles; maximum speed, rate-of-climb, range, and endurance; basic stability and control, weight, and balance.

BME 210 – **Biomedical Computer Simulation Methods**
Computational methods for simulation of circulatory, respiratory, pharmacokinetic, and neural models. Quadrature, differential equations, systems of linear equations, simulation languages, experimental statistics.

Miscellaneous Projects

08/20 – Present **Investigating the Application of Spiking Neural Networks to Plasma Disruption Prediction in Tokamaks**.
Spiking neural networks show promise for the task of learning to predict plasma disruptions in tokamaks in real time for two primary reasons. First, their inherent short-term memory gives them an affinity for learning time-series problems. Second, because activity can propagate to higher layers asynchronously, rapid initial classification is possible. This fast response is potentially useful in plasma control systems, which need to predict disruption events within a maximally long warning window in order to take countermeasures. This project uses shot data from the DIII-D tokamak in San Diego.

03/20 – 04/20 **Generating Statistically Random Numbers from Chua's Circuit**.

An experiment was designed for AME 341b (Mechoptronics Laboratory II) to utilize the nonlinear dynamics governing Chua's circuit to create a hardware implementation of a statistically random number generator. While the experiment could not be carried out due to Covid-19 circumstances, a set of circuit parameters was identified that is expected to pass the requisite suite of NIST tests to statistically verify randomness. The experiment included a review of chaotic systems and phase space attractors.