

# CHRISTIAN A. SHEWMAKE

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## OBJECTIVE

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I am actively seeking Ph.D. and research assistant positions that explore the rich mathematical connections between deep and manifold learning, dynamical systems, differential geometry, and neural computation. I am also pursuing projects applying these methods to artificial intelligence, brain-computer interfaces, and neuroscience.

## RELEVANT EXPERIENCE

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**2019 | Independent Study, Brain Dynamics and Control Research Lab**, Prof. ShiNung Ching, St. Louis, MO

Focus: Dynamic Persistent Memory in Spiking Neural Networks

- Proposed definition of dynamic persistent memory in terms of invariant quantities, constructed family of recurrent McCulloch-Pitts neural networks exhibiting this property
- Demonstrated that a deep neural network could converge to a decoder that recovers the stored vector
- Explored method using deep autoencoders to reduce high-dimensional systems to lower-dimensional reparameterizations and discover conserved quantities

**2019 | Data Science for Social Good Research Fellow**, University of Chicago, Imperial College, Turing Institute, UK

Focus: Predict high users of ambulance services based on three years of 911 call and ambulance records

- Provided descriptive statistics about patients, EMS interactions, and outcomes
- Delivered a machine learning model to identify future high-utilizers of ambulance services for preventative care
- Held brainstorming meetings, stakeholder briefs, and discussions with city officials and employees
- Developed and maintained extensive documentation and a Github repository for the project (public soon)

**2018 | Computational Modeling and Systems Engineer**, Koniku Inc., Berkeley, CA

- Developed reliable, real-time explosive identification with machine learning models and our wetware chips
- Redesigned genetic engineering and olfactory receptor screening for high-throughput automation
- Created software to automate control of microscopes and microfluidics, collect image data for experiments
- Wrote Python code to tag, upload, visualize, and analyze calcium imaging and microelectrode array data
- Managed the development of Django app for exploration, analysis, and reporting of experimental findings
- Led a team to model and optimize phase and transport dynamics of trace explosives

## EDUCATION

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**2018 - 2019 | M.S. in Systems Science and Mathematics**, Washington University in Saint Louis

Independent Study Topic: Dynamic Persistent Memory in Spiking Neural Networks

Fall: Analysis, Linear Dynamic Systems, Probability & Stochastic Processes, Optimization

Spring: Nonlinear Dynamic Systems, Machine Learning, Optimization & Optimal Control, Rapid Prototype Development

**2013 - 2017 | B.S. Biomedical Engineering**, Washington University in Saint Louis

Majors: Biomedical Engineering, Applied Mathematics, Minor: Computer Science

Thesis: SomniScan—A Smart, Low-Cost Sleep Disorder Screening Device

Credits Taken: 157, Credits Required: 120

**2016 - 2017 | Winter Course in Complexity** New England Complex Systems Institute, MIT Campus

Complexity Science, Dynamical Systems Modeling, and Network Theory

**2016 | International Summer Exchange Program** Hong Kong University of Science and Technology, Hong Kong, China

Political Theory and Comparative Politics, Development of Modern China

## ACADEMIC RESEARCH PROJECTS

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**2019 | Brain Dynamics and Control Research Lab**, Professor ShiNung Ching, St. Louis, MO

*see Relevant Experiences above*

**2016 | Independent Study, Multiscale Dynamics, Modeling, and Simulation Lab**, Professor Jon Silva, St. Louis, MO

Research Focus: Parameter Estimation for Ion Channel Dynamics in Cardiac Chaos

- Investigated the relationship between ion channel dynamics, whole-cell behavior, and emergent chaos in tissues
- Studied mathematical models of ion channel dynamics, especially Hidden Markov Models
- Improved the simulated annealing algorithm (C++) for HMM parameter estimation from lab patch-clamp data
- Trained an incoming PhD student on the codebase and areas for improvement

**2015 | Summer Volunteer, Brain Dynamics and Control Research Lab**, Professor ShiNung Ching, St. Louis, MO

Research Focus: EEG Analysis of Sleep, Seizure, and Coma

- Designed a pipeline in Matlab for analyzing thousands of gigabytes of multi-patient, high sample rate EEG data
- Explored differing spectral compositions characteristic of healthy and compromised sleep phases
- Explored *input novelty*, a metric designed by the lab to understand stimulus classification in olfactory networks

## INDUSTRY RESEARCH AND DEVELOPMENT

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**2019 | Data Science Consultant**, Atlas Coffee Club, Austin, TX

- Developed end-to-end data science pipeline, performance tests, and ML model deployment process with C-suite
- Designed ML models that reduced first-month customer churn by 2 percentage points (8% to 6%)

**2019 | Data Science For Social Good Research Fellow**, University of Chicago, Imperial College, Turing Institute, UK

*see Relevant Experiences above*

**2018 | Computational Modeling and Systems Engineer**, Koniku Inc., Berkeley, CA

*see Relevant Experiences above*

**2017 | Volunteer Data Strategy Consultant**, The OneSky Foundation, Beijing, China

OneSky has brought nurturing care to China's understaffed orphanages since 1998. The government's primary partner for orphan services, they've worked with 100+ child welfare institutions, trained 30,000+ staff, and served 100,000+ children.

- Designed a project to enable the foundation to collect and analyze valuable data from their child care program sites, empowering office staff to quantitatively demonstrate impact
- Created three internship positions in the foundation's Beijing HQ and formed a team to complete the project
- Presented findings, cost analysis, and proposal to the COO, CTO, Director of Ops, and Programs Director

## GRANTS AND FELLOWSHIPS

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**2020 | GeomStats Hackathon**, INRIA Sophia Antipolis-Méditerranée Research Centre. Host: Xavier Pennec, Epione Group

- Travel, accommodation, and expenses funded

**2019 | Data Science for Social Good Fellowship**, Data Science for Social Good Foundation, London, UK (acc. rate 4%)

- \$1500 Travel grant, generous monthly stipend

**2017 | The OneSky Foundation Project**, WUSTL Summer Intern Funding, Beijing, China

- \$1000 Travel grant

**2014, 2016 | Research & Development Grant**, The Engineering Projects Review Board, Washington University in St. Louis

- \$600 for AmoxiDerm/ChitoTrans, \$1000 for SomniScan

## PAPERS, TALKS, AND POSTER PRESENTATIONS [P, T, PO]

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2020 | [P] N Miolane, A Brigant, J Mathe, B Hou, N Guigui, Y Thanwerdas, S Heyder, O Peltre, N Koep, H Zaatiti, H Hajri, Y Cabanes, T Gerald, C Shewmake, B Kainz, C Donnat, S Holmes, X Pennec. **Geomstats: A Python Package for Riemannian Geometry in Machine Learning**. In preparation for JMLR submission, 2020.

2020 | [T] N Miolane, A Brigant, J Mathe, B Hou, N Guigui, Y Thanwerdas, S Heyder, O Peltre, N Koep, H Zaatiti, H Hajri, Y Cabanes, T Gerald, C Shewmake, B Kainz, C Donnat, S Holmes, X Pennec. **Geomstats: A Python Package for Riemannian Geometry in Machine Learning**. Submitted to SciPy 2020.

2019 | [PO] **Helping Emergency Medical Services to Identify High Utilizers for Proactive Care Services**, DSSG Datafest 2019 Poster Session @ Imperial College London, UK

2019 | [T] **Identifying 911 High Utilizers for Proactive Care Services in Memphis, TN**, DSSG Datafest 2019 @ Imperial College London, UK

2019 | [T] **A Plug for Manifold Learning**, DSSG Fellow Talks (Internal) @ Imperial College London, UK

2019 | [T] **Using Data Science to Identify Potential 911 High Utilizers**, Data for Memphis Public Services, Memphis, TN

2019 | [T] **Dynamics on Learned Manifolds**, Chalk Talks @ Washington University in St. Louis, MO

2019 | [T] **STEM, Systems Science, & the Startup Experience**, Career Panel @ Washington University in St. Louis, MO

2017 | [PO] **SomniScan: Bringing Sleep Testing Home**, Biomedical Engineering Day Poster Session @ Washington University in St. Louis, MO

## TEACHING EXPERIENCE

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2016 | **Teaching Fellow**, LaunchCode, St. Louis, MO

- Worked 100+ hours reviewing material, preparing lessons, holding office hours, and teaching students on weeknights
- Taught basic C, algorithms, data structures to 200+ St. Louis adults, most of whom were without college degrees and/or from underrepresented groups in STEM

2016 | **Rapid Device Prototyping Instructor**, Biomedical Engineering Society, Engineering World Health

- Planned three device design workshops for students who wanted hands-on prototyping experience
- Taught sessions on planning projects, acquiring material and financial resources, designing software and circuits, basic CAD design and 3D-printing, and troubleshooting

2014 | **Calculus III Peer Led Team Learning (PLTL) Leader**, St. Louis, MO

- Taught two, two hour sections each week of Calculus III supplementary classes with eight students each
- My students were among the top scorers in the course, and four became PLTL leaders the following year

## AWARDS AND HONORS

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2014, 2017 | **The Engineering Discovery Competition Award**, St. Louis, MO

- SomniScan: Finalists | \$2500 Cash Award, \$2500 in Legal Services
- AmoxiDerm/ChitoTrans: Semifinalists | \$1000 Prototyping Award

## ADDITIONAL ACTIVITIES

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2020 - Pres. | **Contributor**, [Geomstats](#): Python library for computation and statistics on manifolds with geometric structures

2020 - Pres. | 2020 Cohort Selection Committee Member, Data Science for Social Good Fellowship @ CMU

2013 - 2015 | Co-founder, Executive Board Member, Engineering World Health, St. Louis, MO

2014 - 2015 | Executive Board Member, Biomedical Engineering Society, St. Louis, MO

2014 - 2015 | Executive Board Member, Engineer's Council, St. Louis, MO

## LANGUAGES AND RELEVANT SKILLS

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- **Programming Languages (by proficiency):** Python, Matlab/Simulink, C++, R, Java
- **Python Libraries:** numpy, pandas, scikit-learn, scipy, matplotlib, keras/tensorflow, geomstats, catboost, functools, kedro
- **Tools/Platforms:** Git, Github, AWS EC2 & S3, Heroku, GCloud, Linux/Unix Shell, VIM, Jupyter Notebooks
- **Web Languages/Frameworks:** Django (Python), Javascript, Node.js, HTML, CSS, SQL
- **Documentation/Communication:** LaTeX, Markdown (md, rst), Python numpdoc standard, Sphinx,
- **Project Management:** partner relationship building, scoping and timelining, team orchestration, terms negotiation
- **Natural Languages:** English (native), Mandarin (HSK Level II)

References available upon request