

# Pake Melland

Southern Methodist University, Department of Mathematics, Postdoctoral Fellow

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## EDUCATION

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<b>The University of Iowa</b> <i>Ph.D. in Applied Mathematical &amp; Computational Sciences</i> Advisor: Rodica Curtu Thesis: Dynamic features of auditory bistable perception extracted from human ECoG recordings	Iowa City, IA May 2021
<b>The University of Iowa</b> <i>M.S. in Mathematics</i>	Iowa City, IA May 2017
<b>North Dakota State University</b> <i>B.S. in Mathematics &amp; Mathematics Education,</i>	Fargo, ND Dec 2014

## ACADEMIC AND PROFESSIONAL APPOINTMENTS

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<b>Southern Methodist University</b> NSF-RTG postdoctoral fellow & visiting assistant professor	Fall 2021– present
<b>The University of Iowa</b> Graduate student & teaching assistant	Fall 2015–Spring 2021
<b>Los Alamos National Laboratory</b> NSF-Mathematical Sciences Graduate Internship (MSGI)	Summer 2019
<b>Fargo Shanley High School</b> Geometry & Algebra teacher	Spring 2015
<b>North Dakota State University</b> Course instructor (as an undergraduate)	Fall 2013

## RESEARCH INTERESTS

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Mathematical neuroscience · Data-driven modeling · Dynamical systems · Differentiable programming

## PUBLICATIONS AND PREPRINTS

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### Manuscripts under review

- [1] **P. Melland** and R. Curtu. Attractor-like dynamics within human electrocorticographic recordings underlie computational principles of auditory bistable perception. *Revisions Submitted*: November 2022.

### Journal articles

- [2] **P. Melland**, E.J. Albright, and N. Urban. (2020). Differentiable programming for online training of a neural artificial viscosity function within a staggered grid Lagrangian hydrodynamics scheme. *Mach. Learn.: Sci. Technol.* in press <https://doi.org/10.1088/2632-2153/abd644>.

## Manuscripts in preparation

- [3] **P. Melland**, Z. Aminzare, and R. Curtu. Spike adding mechanism in fitzhugh-nagumo model with periodic forcing. *In preparation*

## Refereed conference abstracts

- [4] **P. Melland** and R. Curtu. (2020). Exploring fast and slow neural correlates of auditory perceptual bistability with diffusion-mapped delay coordinates. Computational Neuroscience Meeting (CNS\*2020). Get abstracts (section P31). <https://bmcneurosci.biomedcentral.com/articles/10.1186/s12868-020-00593-1>.
- [5] **P. Melland**, B. McMurray, and R. Curtu. (2019). Using dynamic neural fields to examine loci of plasticity in supervised and unsupervised auditory category learning. International Conference on Mathematical Neuroscience (ICMNS). Get abstracts (pdf), pp. 60. <http://web.math.ku.dk/~susanne/ICMNS/downloads/abstracts.pdf>.
- [6] **P. Melland**, B. McMurray, R. Curtu. (2019). Dynamic neural field modeling of auditory categorization tasks. Computational Neuroscience Meeting (CNS\*2019). 2019. Get abstracts (pdf), pp. 35. <https://bmcneurosci.biomedcentral.com/track/pdf/10.1186/s12868-019-0538-0.pdf>.

## PROJECTS IN PROGRESS

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### *Spike-sorting from sparse spike events*

With A.K. Barreiro (SMU) & B. Pfeiffer (UT Southwestern)

### *Smooth forcing of a single FitzHugh-Nagumo neuron*

With Z. Aminzare & R. Curtu (U of Iowa)

### *Timeseries analysis of simulated hippocampal theta sequences*

With R. Parker, A.K. Barreiro, & K. Hedrick (SMU)

## TEACHING

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Southern Methodist University	Role	Term	Students	Rating
Calculus II	Instructor	Sp22	26	4.41/5.00
Calculus I	Instructor	Fa21	36	4.19/5.00
<b>University of Iowa</b>				
Qualifying exam preparation in differential equations	Instructor	Su20	18	–
PDEs with numerical methods ( <b>graduate</b> )	TA	Sp20	21	5.92/6.00
Nonlinear dynamics with numerical methods ( <b>graduate</b> )	TA	Fa19	19	5.90/6.00
Calculus II	TA	Sp19	49	5.81/6.00
Qualifying exam preparation in numerical analysis	Instructor	Su18	5	–
TA training for multivariable calculus	Instructor	Su18	12	–
Multivariable calculus for engineers	TA	Sp18	61	5.78/6.00
Multivariable calculus for engineers ( <b>honors</b> )	TA	Fa17	53	5.52/6.00
Calculus I	TA	Sp17	43	5.89/6.00
Multivariable calculus for engineers	TA	Fa16	51	5.77/6.00
Mathematics for Business	TA	Sp16	55	5.57/6.00
Mathematics for Business	TA	Fa15	49	5.37/6.00
<b>North Dakota State University</b>				
Intermediate algebra	Instructor	Fa13	20	–

# PRESENTATIONS

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## Poster Presentations

- Exploring fast and slow neural correlates of auditory perceptual bistability with diffusion-mapped delay coordinates** Virtual  
P. Melland and R. Curtu July 2020  
*Computational Neuroscience*  
[Get abstracts \(pdf\)](#), pp. 55. [Get poster](#).
- Dynamic neural field modeling of auditory categorization tasks** Barcelona, Spain  
P. Melland, B. McMurray, and R. Curtu July 2019  
*Computational Neuroscience*  
[Get abstracts \(pdf\)](#), pp. 35. [Get poster](#).
- Why is comparing neuro-computation in different species so important?** San Antonio, TX  
S. Ibañez, T. Lagache, and P. Melland Feb 2019  
*Future frameworks of theoretical neuroscience: University of Texas at San Antonio Meeting information*. [Get poster](#).
- Diffusion maps and their application to auditory streaming of triplets** Raleigh, NC  
P. Melland and R. Curtu July 2018  
*Research training group: North Carolina State University*  
[Workshop information](#). [Get poster](#).

## Invited talks

- Artificial and biological neural networks: Using data to inform dynamic models** Dallas, TX  
*UT Dallas Computational Science Seminar* Nov 2022
- Extracting intrinsic neural features of bistable perception with the extended DMD** Pittsburgh, PA  
*SIAM conferences on the life sciences* July 2022
- Spiking neurons in extracellular recordings and numerical simulations** Iowa City, IA  
*University of Iowa* June 2022
- Incorporating data when equations are not enough** Ogden, UT  
*Weber State University Math factor meeting* Feb 2022
- Discovering neural features of auditory bistable perception from human ECoG data** Dallas, TX  
*SMU mathematics colloquium series* Sep 2021

## Contributed talks

- Automatic differentiation and differentiable programming: Expanding deep learning architectures** Iowa City, IA  
*Mathematical Biology Seminar: University of Iowa* Nov 2019
- Exploring national labs as an applied mathematician: My summer as a guest scientist** Iowa City, IA  
*Mathematical Biology Seminar: University of Iowa* Oct 2019
- Automatic machine learning enhanced artificial viscosity to suppress spurious oscillations near shocks in a staggered-grid Lagrangian scheme** Los Alamos, NM  
*Los Alamos National Laboratory* Aug 2019
- Should I wear a coat? Decision making in a changing environment** Iowa City, IA  
*GAUSS Seminar: University of Iowa* April 2019
- Auditory categorization: A dynamic field approach** Iowa City, IA

<i>Mathematical Biology Seminar: University of Iowa</i>	Dec 2018
<b>An introduction to the Kalman Filter</b> <i>Mathematical Biology Seminar: University of Iowa</i>	Iowa City, IA Sep 2018
<b>An iterative analysis of neuronal structure using diffusion maps</b> <i>Mathematical Biology Seminar: University of Iowa</i>	Iowa City, IA Feb 2018
<b>An introduction to diffusion maps</b> <i>Mathematical Biology Seminar: University of Iowa</i>	Iowa City, IA Oct 2017
<b>Dualing objectives</b> <i>Applied Student Seminar: University of Iowa</i>	Iowa City, IA March 2017

## PROFESSIONAL WORKSHOPS

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<b>Present and future frameworks of theoretical neuroscience</b> University of Texas at San Antonio	San Antonio, TX Feb 2019
<b>Workshop on parameter estimation for mechanistic biological models</b> North Carolina State University RTG	Raleigh, NC July 2018

## SERVICE AND OUTREACH

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<b>REU mentor</b> <i>Replays and ripples in the hippocampus</i> Research experience for undergraduates in mathematical neuroscience	Dallas, TX July 2022
<b>Poster judge</b> <i>Research and innovation week, SMU</i> Judged two undergraduate posters with applications in fluid dynamics and machine learning in chemistry	Dallas, TX March 2022
<b>Mathematical Biology Seminar organizer</b> Invited inside and outside speakers to departmental seminar	Iowa City, IA Fall 2019
<b>Directed reading program: University of Iowa</b> <i>Diffusion maps for noisy periodic data</i> Mentored undergraduate statistics student Abdul-Rahman Shiwoku on a semester-long reading/coding project.	Iowa City, IA Fall 2019
<b>Applied Mathematics Student Seminar organizer</b> Re-started a supportive seminar for graduate students to present research	Iowa City, IA Fall 2018–Fall 2019
<b>Math Graduate Board: University of Iowa</b> <i>Chair</i> Developed graduate funding committee to allocate travel funds for graduate students; Organized first ‘math day’ for summer youth camp.	Iowa City, IA 2018
<i>Vice-chair</i> Helped secure external funding from ACT for math outreach event to local elementary school; Organized weekly lunch social events for department.	2017
<i>Social co-chair</i> Organized department social events; Coordinated with faculty for student visitation weekend.	2016
<b>Sonia Kovalevsky Day (for women in STEM): University of Iowa</b> Speaker organizer Registration attendant Fund-raising committee member	Iowa City, IA April 2019 April 2018, 2019 Feb 2017

## AWARDS, GRANTS, & HONORS

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### Thank-a-teacher recipient

Southern Methodist University

Fall 2021

### SIAM student travel award

Waived conference fees for virtual SIAM-DS

Spring 2021

### Ballard and Seashore Dissertation Fellowship: University of Iowa

\$10,000 dissertation fellowship

Spring 2021

### NSF Mathematical Science Graduate Internship

\$12,000 internship stipend

Summer 2019

### DeLTA center Interdisciplinary Research Grant: University of Iowa

\$1,000 grant used to purchase computer

Spring 2019

### Outstanding TA Award: University of Iowa

\$1,000 cash award

Spring 2019

### Theoretical Neuroscience Workshop: NSF Award Number–1820631

\$450 airfare + housing

Spring 2019

### Graduate College Post-Comprehensive Research Fellowship: University of Iowa

\$9,500 research fellowship

Fall 2018

### RTG Mathematical Biology Workshop: NSF grant RTG/DMS–1246991

\$600 airfare + housing

Summer 2018

### Summer Fellowship: University of Iowa, AMCS

\$4,000 research fellowship

Summer 2017

\$3,466 research fellowship

Summer 2016

### Thank-a-teacher recipient

University of Iowa

Spring 2016

## OUTSIDE GRADUATE-LEVEL COURSEWORK

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### Biostatistical methods I & II

Fall 2018–Spring 2019

*Texts: Biostatistics (Belle et al.); Applied linear statistical models (Kutner)*

Statistical inference, parametric & non-parametric statistics, introductory Bayesian methods, bootstrapping, regression, ANOVA.

### Foundations of cognitive & behavioral neuroscience

Spring 2018

*Text: Neurobiology of learning & memory (Rudy)*

Concepts, methods, and findings in behavioral and cognitive neurosciences including classic and recent article discussions.

### Fundamentals of neurobiology

Fall 2017

*Text: Neuroscience (Purves et al.)*

Neurobiology from molecular to system levels including discussion of classic and recent journal articles.

### Digital signal processing

Fall 2017

*Text: Discrete-time Signal Processing (Oppenheim et al.)*

Theory & techniques used in discrete time signals including digital filter theory and design.

### Nonlinear Optimization

Fall 2016

*Text: Nonlinear programming: theory and algorithms (Bazaraa et al.)*

Mathematical theory and algorithms for nonlinear optimization including duality theory and machine learning.

# PROFESSIONAL SKILLS

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## Fluency in

$\text{\LaTeX}$ , MATLAB, and *Julia*

## Basic fluency in

*Wolfram Mathematica*, *Python*, and *R*

## REFERENCES

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**Dr. Rodica Curtu (PhD advisor)**

Professor, University of Iowa

[rodica-curtu@uiowa.edu](mailto:rodica-curtu@uiowa.edu)

**Dr. Andrea Barreiro (Postdoc mentor)**

Associate Professor, Southern Methodist University

[abarreiro@smu.edu](mailto:abarreiro@smu.edu)

**Dr. Zahra Aminzare**

Assistant Professor, University of Iowa

[zahra-aminzare@uiowa.edu](mailto:zahra-aminzare@uiowa.edu)

**Dr. Jason Albright**

Scientist, Formerly of Los Alamos National Laboratory

[ejasonalb@gmail.com](mailto:ejasonalb@gmail.com)

**Dr. Colleen Mitchell (Teaching)**

Associate Professor, University of Iowa

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**Dr. Daniel Reynolds (Teaching)**

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