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Joel Zirkle

Current Position

2020–Present **ORISE Postdoctoral Fellow**, *FDA/CDER/DARS*, White Oak, MD

Lead modeler on a cardiac safety project (CiPA). I am working to develop and validate a mathematical model to fit multi-laboratory electrophysiology data. The output of such model is a metric to assess a drug's cardiac safety potential. Various facets of the projects include PK/PD modeling, Markov modeling of ion channels, large-scale parallel simulations on FDA HPC clusters, Bayesian statistics (e.g. hierarchical models).

Tangential to CiPA, I worked on a natural language processing project aimed at extracting PK DDIs from natural text. Specifically I manually re-annotated a corpus and then helped train and validate the NLP model. As a use-case I ran the model on all human prescription FDA drug labels and extracted all PK DDIs involving a list drugs involved in the CiPA project.

Assisted on an opioids project (aimed that informing regulatory guidelines about naloxone usage) with a global sensitivity analysis of model parameters and with constructing a Bayesian hierarchical model.

Education

2015–2020 **Ph.D in Applied Mathematics**, *Purdue University*, Indianapolis
Dissertation: *Modeling Temporal Patterns of Neural Synchronization: Synaptic Plasticity and Stochastic Mechanisms*

2017–2020 **MS in Applied Statistics**, *Purdue University*, Indianapolis

2011–2015 **BS with Highest Distinction in Pure Mathematics**, *Purdue University*, Indianapolis, 3.95 GPA

2011–2015 **BS with Highest Distinction in Physics**, *Purdue University*, Indianapolis

Employment History

2015–2020 **Instructor**, *Purdue University*, Department of Mathematics, Indianapolis
I have taught the following courses:

1. Business Calculus (M119) Spring 2016, Summer 2016.
2. Trigonometry (MA15400) Fall 2016, Spring 2017, Fall 2017, Summer 2018.
3. Fundamentals of Algebra I (MA11000) Fall 2017.
4. Calculus I (MA16500) Spring 2018, Fall 2018.
5. College Algebra (MA15300) Spring 2019.
6. Multidimensional Math (MA17100) Summer 2019.
7. Calculus I for Life Sciences (MA23100) Fall 2019.
8. Calculus II for Life Sciences (MA23200) Spring 2020, Summer 2020.

2014–2015 **Assistant Manager**, *Mathematics Assistance Center*, Indianapolis
Managed daily operations for a facility that employed 100+ persons, including directly managing a team of 10-15 calculus tutors. Produced various study materials, e.g. a 150+ page study reference for calculus.

Publications

[1] Joel Zirkle et al. "Deep learning-enabled natural language processing to identify directional pharmacokinetic drug–drug interactions". In: *BMC Bioinformatics* 24.1 (Nov. 2023), p. 413. ISSN: 1471-2105. DOI: 10.1186/s12859-023-05520-9. URL: https://doi.org/10.1186/s12859-023-05520-9.

[2] John Mann et al. "Development of a Translational Model to Assess the Impact of Opioid Overdose and Naloxone Dosing on Respiratory Depression and Cardiac Arrest". In: *Clinical Pharmacology & Therapeutics* 112.5 (2022), pp. 1020–1032. DOI: https://doi.org/10.1002/cpt.2696. eprint: https://ascpt.onlinelibrary.wiley.com/doi/pdf/10.1002/cpt.2696. URL: https://ascpt.onlinelibrary.wiley.com/doi/abs/10.1002/cpt.2696.

[3] Mohammadreza Samieegohar et al. "Calibration and Validation of a Mechanistic COVID-19 Model for Translational Quantitative Systems Pharmacology – A Proof-of-Concept Model Development for Remdesivir". In: *Clinical Pharmacology & Therapeutics* 112.4 (2022), pp. 882–891. DOI: https://doi.org/10.1002/cpt.2686. eprint: https://ascpt.onlinelibrary.wiley.com/doi/pdf/10.1002/cpt.2686. URL: https://ascpt.onlinelibrary.wiley.com/doi/abs/10.1002/cpt.2686.

[4] Joel Zirkle and Leonid L. Rubchinsky. "Noise effect on the temporal patterns of neural synchrony". In: *Neural Networks* 141 (2021), pp. 30–39. ISSN: 0893-6080. DOI: https://doi.org/10.1016/j.neunet.2021.03.032. URL: https://www.sciencedirect.com/science/article/pii/S0893608021001209.

[5] Joel Zirkle and Leonid L. Rubchinsky. "Spike-Timing Dependent Plasticity Effect on the Temporal Patterning of Neural Synchronization". In: *Frontiers in Computational Neuroscience* 14 (2020). ISSN: 1662-5188. DOI: 10.3389/fncom.2020.00052. URL: https://www.frontiersin.org/articles/10.3389/fncom.2020.00052.

Selected Presentations

December 2023 internal FDA CiPA group. *CiPA2.0 Preliminary Validation After Incorporating Inter-Experimental Variabilities.*

October 2023 FDA sponsored OCP Day. *Deep Learning-enabled Natural Language Processing to Identify Clinical Exposure Changes of Object Drugs Due to Drug-Drug Interactions with Precipitant Drugs.* (poster)

February 2023 internal FDA/CDER/DARS. *Deep Learning-enabled Natural Language Processing to Identify Clinical Exposure Changes of Object Drugs Due to Drug-Drug Interactions with Precipitant Drugs.*

March 2021 internal FDA/CDER/DARS. *Global Sensitivity Analysis of Opioid Parameters.*

Summer 2020 29th Annual Computational Neuroscience Meeting (virtual). *The impact of noise on the temporal patterning of neural synchronization.* (poster)

Spring 2018 Computational and Systems Neuroscience Symposium, Purdue University, Indianapolis. *Spike-timing-dependent plasticity effect on the patterns of neural synchrony.* (poster)

Spring 2018 Annual Meeting for Greater Indiana Society for Neuroscience. *Spike-timing-dependent plasticity effect on the patterns of neural synchrony.* (poster)

Fall 2017 On-campus SIAM event, Indianapolis. *Synchronization between Weakly Coupled Neurons.*

Awards

October 2023 FDA Team Excellence Award (*Naloxone Dosing Project Team*).

Spring 2018 Graduate Student Teaching Award.

2015 2015 Yuri Abramovich Memorial Scholarship.

2015 Pure Math Outstanding Senior.

Professional Skills and Trainings

Languages python, R, bash

Software STAN, TensorFlow, sun grid engine (SGE), git, MATLAB, XPP, SAS, LaTeX

Training MIDD Training Course, Critical Path Institute

References

Professional Dr. Zhihua Li (postdoctoral advisor). Zhihua.Li@fda.hhs.gov

Research and Academic Dr. Leonid Rubchinsky (doctoral advisor). *Professor of Applied Mathematics at IUPUI.* Affiliated with Stark Neurosciences Research Institute and IU School of Medicine. 317 274 9745 or lrubchin@iupui.edu

Academic Dr. Julia Arciero. *Associate Professor of Applied Mathematics at IUPUI.* 317 274 6998 or jarciero@iupui.edu.