

# Joel Zirkle

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## Current Position

2020–**ORISE Postdoctoral Fellow, FDA/CDER/DARS, White Oak, MD**  
Present 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 at informing regulatory guidelines about naloxone usage) with a global sensitivity analysis of model parameters and with constructing a Bayesian hierarchical model.

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## 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**

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## 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.

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## 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>.

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## 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, L<sup>A</sup>T<sub>E</sub>X
- 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.