

# Abhishek Mallela

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## SUMMARY

Research scientist with 12+ years of experience in modeling and computation across various biological subfields. Expert in TensorFlow, JAX, and Python, with a strong background in deep learning and mathematical modeling. Eager to contribute to innovative projects in modeling and machine learning.

## EDUCATION

*Applied Math, PhD, Mar '22; GPA: 3.74*

University of California at Davis, Davis, CA

*Applied Stats and Analytics, MS, May '17; GPA: 3.90*

University of Kansas Medical Center, Kansas City, KS

*Math and Stats, MS, May '15; BS, Dec '11; GPA: 4.00; 3.81*

University of Missouri at Kansas City, Kansas City, MO

## SKILLS

- Programming: Python, MATLAB, R, Julia, LaTeX, Mathematica, basic C++, and shell scripting
- AI/ML: Automatic differentiation; Completed Deep Learning, Natural Language Processing, and Foundations of Algorithms and Data Structures specializations (Coursera)
- Data: Pre- and post-processing of COVID-19 surveillance data across all US counties and county equivalents
- Communication: 18 publications, 5 invited talks, 9 contributed talks and posters, cross-disciplinary expertise, and proficiency in technical writing

## EXPERIENCE

- *Postdoctoral Fellow (Lab of Santiago Schnell at University of Notre Dame and Dartmouth College; Feb '25 to present)*
  - **Modeling:** Designing and estimating the parameters of enzyme-catalyzed experiments and designing a mathematical model of a minimal mechanism for hormesis in protein aggregation.
  - **AI/ML:** Collaborating with researchers at Harvard University on an effort involving repeated games with LLMs.
- *Postdoctoral Fellow (Center for Nonlinear Studies at Los Alamos National Laboratory; May '22 to Jan '25)*
  - **Modeling:** Estimated the basic reproduction number for COVID-19 in 50 US states and 280 urban areas, identifying regions at risk of high disease transmission and aiding future pandemic preparedness. *Techniques used: Bayesian inference, Adaptive MCMC algorithm, and convergence diagnostics.*
  - **Collaboration:** Contributed significantly to the collective efforts of a large consortium of COVID-19 researchers.
  - **Software:** Python (NumPy, SciPy, Jax, Diffrax, Pandas, Jupyter Notebook, Keras, TensorFlow, Numba); Julia
  - **Achievements:** 8 peer-reviewed publications (3 as first-author), 2 international conference talks, 3 invited talks, 1 local poster presentation.
- *PhD Candidate, Graduate Teaching Assistant, and Tutor (University of California at Davis; Sep '17 to Mar '22)*
  - **Modeling:** Explored the stochastic aspects of coupled bistable systems arising from the Allee effect in ecology. Found that changing one parameter in multi-dimensional systems can result in tipping point cascades, common in many fields and across spatial scales. *Techniques used: Stochastic Differential Equations, Individual-Based Models, Fourier transforms, Partially Observable Markov Decision Processes*
  - **Achievements:** PhD degree with 3 first-author publications, TA and tutor for several math courses.
- *Graduate Research Associate (University of Kansas; Oct '15 to Sep '17)*
  - **Modeling:** Developed mathematical models to analyze a) post-translational modification cycles subject to synthesis and degradation, and b) length control of bacterial structure assembly. Used an agent-based framework based on the stochastic Doob-Gillespie algorithm to efficiently simulate the models numerically on a computer cluster. Achieved a 100x speedup by switching from MATLAB to Python and then C++.
  - **Software:** MATLAB, Python, C++, Kappa, BNGL, R, Mathematica
  - **Achievements:** 2 peer-reviewed publications (1 as first-author), 2 local poster presentations.
- *Graduate Student Researcher and Course Instructor (University of Missouri at Kansas City; Aug '13 to May '15)*
  - **Modeling:** Designed, analyzed, and simulated an ODE model of HIV-TB co-infection. Formulated and solved an optimal control problem to simultaneously minimize disease burden and implementation cost.
  - **Collaboration:** Led project with research supervisor and external collaborator, a world-class expert in optimal control theory, to design an optimal treatment protocol for HIV-TB co-infected populations.
  - **Achievements:** 1 first-author publication, 1 first-place poster prize (500 USD), 2 international conference talks, 3 invited talks, Adjunct Instructor of Record (Trigonometry and College Algebra).

## PUBLICATIONS

1. *Strategies of cooperation and defection in five large language models*. Pal, S., **Mallela, A.**, Hilbe, C., Pracher, L., Wei, C., Fu, F., Schnell, S., and Nowak, M. ('26), aRxiv preprint, Under Review
2. *Structural hormesis in protein aggregation: A minimal mechanistic model*. **Mallela, A.** and Schnell, S. ('25), bioRxiv preprint, Accepted
3. *Using PyBioNetFit to Leverage Qualitative and Quantitative Data in Biological Model Parameterization and Uncertainty Quantification*. Miller, E.F., **Mallela, A.**, Neumann, J., Lin, Y.T., Hlavacek, W.S., and Posner, R.G. ('25), aRxiv preprint, Accepted
4. *Evaluation of FluSight influenza forecasting in the 2021-22 and 2022-23 seasons with a new target laboratory-confirmed influenza hospitalizations*. Mathis, S.M., Webber, A.E., Basu, A., **et al.** ('24), Nature Communications, 15:6289
5. *Impacts of vaccination and Severe Acute Respiratory Syndrome Coronavirus 2 variants Alpha and Delta on Coronavirus Disease 2019 transmission dynamics in four metropolitan areas of the United States*. **Mallela, A.**, Chen, Y., Lin, Y.T., Miller, E.F., Neumann, J., He, Z., Nelson, K.E., Posner, R.G., and Hlavacek, W.S. ('24), Bulletin of Mathematical Biology, 86(3):31
6. *Differential contagiousness of respiratory disease across the United States*. **Mallela, A.**, Lin, Y.T., and Hlavacek, W.S. ('23), Epidemics, 45:100718
7. *Quantification of early nonpharmaceutical interventions aimed at slowing transmission of Coronavirus Disease 2019 in the Navajo Nation and surrounding states*. Miller, E.F., Neumann, J. Chen, Y., **Mallela, A.**, Lin, Y.T., Hlavacek, W.S., and Posner, R.G. ('23), PLOS Global Public Health, 3(6):e0001490
8. *The United States COVID-19 Forecast Hub dataset*. Cramer, E.Y., Huang, Y., Wang, Y., **et al.** ('22), Scientific Data, 9(462):1-15
9. *Optimal management of stochastic invasion in a metapopulation with Allee effects*. **Mallela, A.** and Hastings, A. ('22), Journal of Theoretical Biology, 549:111221
10. *Bayesian inference of state-level COVID-19 basic reproduction numbers across the United States*. **Mallela, A.**, Neumann, J., Miller, E.F., Chen, Y., Posner, R.G., Lin, Y.T., and Hlavacek, W.S. ('22), Viruses, 14(1):157
11. *Implementation of a practical Markov chain Monte Carlo sampling algorithm in PyBioNetFit*. Neumann, J., Lin, Y.T., **Mallela, A.**, Miller, E.F., Colvin, J., Duprat, A.T., Chen, Y., Hlavacek, W.S., and Posner, R.G. ('22), Bioinformatics, 38(6):1770-1772
12. *Tipping cascades in a multi-patch system with noise and spatial coupling*. **Mallela, A.** and Hastings, A. ('21), Bulletin of Mathematical Biology, 83(11):1-27
13. *Robustness and the evolution of length control strategies in the T3SS and flagellar hook*. Nariya, M.K., **Mallela, A.**, Shi, J.J., and Deeds, E.J. ('21), Biophysical Journal, 120(17):3820-3830
14. *The role of stochasticity in noise-induced tipping cascades: A master equation approach*. **Mallela, A.** and Hastings, A. ('21), Bulletin of Mathematical Biology, 83(5):1-20
15. *Daily forecasting of regional epidemics of Coronavirus disease with Bayesian uncertainty quantification*. Lin, Y.T., Neumann, J., Miller, E.F., Posner, R.G., **Mallela, A.**, Safta, C., Ray, J., Thakur, G., Chinthavali, S., and Hlavacek, W.S. ('21), Emerging Infectious Diseases, 27(3):767
16. *Crosstalk and ultrasensitivity in protein degradation pathways*. **Mallela, A.**, Nariya, M.K., and Deeds, E.J. ('20), PLOS Computational Biology, 16(12):e1008492
17. *Optimal control applied to a SEIR model of 2019-nCoV with social distancing*. **Mallela, A.** ('20), medRxiv preprint
18. *HIV-TB co-infection treatment: modeling and optimal control theory perspectives*. **Mallela, A.**, Lenhart, S., and Vaidya, N.K. ('16), Journal of Computational and Applied Mathematics, 307:143-161