

Xiang Ji

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EDUCATION

Doctor of Philosophy in Bioinformatics and Statistics (Co-Major) *December 2017*

North Carolina State University, Raleigh, NC

Dissertation: Phylogenetic approaches for quantifying interlocus gene conversion

Committee: Jeffrey Thorne, Eric Stone, Nadia Singh, and Sujit Ghosh

Master of Science in Material Science and Engineering *September 2013*

North Carolina State University, Raleigh, NC

Thesis: Laser interference lithography for fabrication of gas sensors

Committee: John Muth, Lew Reynolds, Michael Kudenov, and Jon-Paul Maria

Bachelor of Science in Economics (Double Major) *July 2011*

Peking University, Beijing, China

Bachelor of Science in Physics *July 2011*

Peking University, Beijing, China

Advisor: Jia-sen Zhang

RESEARCH INTERESTS

Multigene family evolution; phylogenetics with large data sets; development of statistical techniques and software

RESEARCH EXPERIENCE

Postdoc Project *Spring 2018 – Present*

Advisor: Marc Suchard

Department of Biomathematics and Human Genetics

University of California, Los Angeles, CA

- Phylogenetic analysis of large viral (and other) data sets via linear time scalable algorithm for calculating likelihood gradient
- Hamiltonian Monte Carlo methods
- C implementation in BEAGLE with CPU and GPU versions
- Java implementation in BEAST

Dissertation Project *Fall 2013 – Fall 2017*

Advisor: Jeffrey Thorne

Bioinformatics Research Center and Department of Statistics

North Carolina State University, Raleigh, NC

- Developed the first statistical phylogenetic model that can quantify interlocus gene conversion in multigene family evolution
- Found that high proportion of nucleotide substitutions in multigene families originated with interlocus gene conversion rather than point mutation
- Implementation in Python of the approaches into freely available software
- Resulted in a successful NSF grant award (DEB 1754142)

Consulting Project*Spring 2016**Employer: Jenny (Qiu-yun) Xiang**Bioinformatics Research Center and Department of Statistics**North Carolina State University, Raleigh, NC*

- De novo assembly of genotyping-by-sequencing reads into DNA sequences
- Population structure analysis
- Species distribution study of past and future over North America

Collaborative Project*Fall 2013 – Spring 2014**Collaborator: Kuangyu Wang**Bioinformatics Research Center and Department of Statistics**North Carolina State University, Raleigh, NC*

- Data mining of solvent accessibility information from protein coding genes in several species

Master Thesis*Fall 2011 – Spring 2013**Advisor: John Muth**Department of Material Science and Engineering**North Carolina State University, Raleigh, NC*

- Derivation of laser interference lithography theory and Matlab implementation of simulation
- Experimental setup of the laser interference lithography in cleanroom
- Fabrication of ozone gas sensor
- Gas sensor characterization

Undergraduate Thesis Project*Fall 2010 – Fall 2011**Advisor: Zhiping Zhou**School of Electronics Engineering and Computer Science**Peking University, Beijing, China*

- Optimization of surface plasmon source doping location inside a waveguide

Undergraduate Research Project*Fall 2009 – Fall 2011**Advisor: Jia-sen Zhang**School of Physics**Peking University, Beijing, China*

- Fortran implementation of 3D surface plasmon light scattering simulation
- Plasmonic lens design with rectangular-shaped slots for sharp focus
- Fabrication of the lens on 200nm gold thin film on glass
- Experimental characterization

WORKING & TEACHING EXPERIENCE

Postdoc Researcher*January 2018 – Present**Advisor: Marc Suchard**Department of Biomathematics and Human Genetics**University of California, Los Angeles, CA*

- Develop and implement novel phylogenetic algorithms
- Mentor Ph.D. students in the Department of Biomath and the Department of Biostatistics
- Collaborative work in Center for Viral Systems Biology (<https://cvisb.org/>) and Artic Network (<http://artic.network/>)

Research Assistant

Fall 2013 – Fall 2017

Advisor: Jeffrey Thorne

Bioinformatics Research Center and Department of Statistics

North Carolina State University, Raleigh, NC

- Development of phylogenetic approaches for quantifying interlocus gene conversion in multigene family evolution
- Mentored two undergraduate summer research assistants (one on ancestral sequence reconstruction and one on the evolutionary alignment of protein tertiary structure)

Research & Teaching Assistant

Fall 2011 – Summer 2013

Department of Material Science and Engineering

North Carolina State University, Raleigh, NC

- Develop Interference laser lithography in Dr. John Muth's lab
- Teach computational laboratory on thin-film interference to MSE undergraduates
- Help design a new MSE undergraduate course on data analysis and experimental design

PUBLICATIONS

- Fisher, A., **Ji, X.**, Nishimura, A., & Suchard, M. A. (2020) Shrinkage-based random local clocks with scalable inference. *in prep*
- Lemey, P., **Ji, X.**, Membrebe, J. V., Martin, D., & Suchard, M. A. (2020) Reconciling fast Hepatitis B evolutionary rates with ancient co-divergence. *in prep*
- He, W. *, **Ji, X.** *, He, W., Dellicour, S., ..., & Su, S. (2019) Genomic epidemiology, evolutionary dynamics, and transmission patterns of porcine deltacoronavirus. submitted to *Molecular Biology and Evolution*, *co-first-author
- Zhang, Z., Nishimura, A., Bastide, P., **Ji, X.**, Payne, R. P., Goulder, P., Lemey, P., & Suchard, M. A. (2019) Large-scale inference of correlation among mixed-type biological traits with phylogenetic multivariate probit models. submitted to *Annals of Applied Statistics*, arXiv:1912.09185 [stat.ME]
- Ji, X.**, Zhang, Z., Holbrook, A., Nishimura, A., Baele, G., Rambaut, A., Lemey, P., & Suchard, M. A. (2019) Gradients *do* grow on trees: a linear-time O(N)-dimensional gradient for statistical phylogenetics. in revision, submitted to *Molecular Biology and Evolution*, arXiv:1905.12146 [stat.CO]
- Fisher, A., **Ji, X.**, Lemey, P., & Suchard, M. A. (2019) Relaxed random walks at scale. *in review*, arXiv:1906.04834[q-bio.PE]
- Bleetsa, M., Suchard, M. A., **Ji, X.**, Gryseels, S., Vrancken, B., Baele, G., Worobey, M., & Lemey, P. (2019) Divergence dating using mixed effects clock modelling: an application to HIV-1. *Virus Evolution*, 5(2), vez036.
- Ji, X.**, Thorne, J. L. (2019) A phylogenetic approach disentangles the tract length and initiation rate of interlocus gene conversions. *in submission*, arXiv:1908.08608 [q-bio.PE]
- Li, G., Zhang, W., Wang, R., Xing, G., Wang, S., **Ji, X.**, ... & Zhou, J. (2019). Genetic Analysis and Evolutionary Changes of the Torque teno sus Virus. *International journal of molecular sciences*, 20(12), 2881.
- Zhou, W., **Ji, X.**, Obata, S., Pais, A., Dong, Y., Peet, R., & Xiang, Q., (2018) Resolving relationships and phylogeographic history of the Nyssa sylvatica complex using data from RAD-seq and species distribution modeling. *Molecular Phylogenetic and Evolution*, 126, 1-16.
- Ji, X.** (2017). Phylogenetic approaches for quantifying interlocus gene conversion. Doctoral Dissertation
- Ji, X.**, Griffing, A., & Thorne, J. L. (2016). A phylogenetic approach finds abundant interlocus gene conversion in yeast. *Molecular Biology and Evolution*, 33(9), 2469-2476.
- Wang, K., Yu, S., **Ji, X.**, Lakner, C., Griffing, A., & Thorne, J. L. (2015). Roles of Solvent Accessibility and Gene Expression in Modeling Protein Sequence Evolution. *Evolutionary Bioinformatics*, 11, 85.

- Ji, X.** (2013). Laser Interference Lithography for Fabrication of Gas Sensors. Master Thesis
- Han, X., **Ji, X.**, Wen, H., & Zhang, J. (2012). H-shaped resonant optical antennas with slot coupling. *Plasmonics*, 7(1), 7-11.
- Xiao, G., **Ji, X.**, Gao, L., Wang, X., & Zhou, Z. (2012). Effect of dipole location on profile properties of symmetric surface plasmon polariton mode in Au/Al₂O₃/Au waveguide. *Frontiers of Optoelectronics*, 5(1), 63-67.

Awards

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| Tuition Scholarship | SISMID ¹ | 2018 |
| NIEHS Fellowship ² | North Carolina State University | 2015 |
| Graduate Fellow | SAMSI ³ | 2014 |
| Tuition Scholarship | SISG ⁴ | 2013 |
| University Graduate Fellowship | North Carolina State University | 2011 |

CONFERENCE PRESENTATIONS

ORAL PRESENTATIONS

- Ji, X.** (2018, September). *Large-scale molecular epidemiology for viruses: efficient algorithms and new models*. Oral session presented at the Taishan Forum on Viral Infectious Diseases, Taishan Medical University, Tai'an, Shandong Province, China
- Ji, X.** (2017, August). *Phylogenetic approaches for quantifying interlocus gene conversion*. Quest for Ortholog 5 Meeting, University of Southern California, Los Angeles, CA, US

POSTER PRESENTATIONS

- Ji, X.** (2017, July). *Phylogenetic approaches for quantifying interlocus gene conversion*. Society of Molecular Biology and Evolution Meeting, Austin, TX, US
- Ji, X.** (2014, June). *A Phylogenetic approach for quantifying interlocus gene conversion*. Evolution Meeting, Raleigh, NC, US

Invited Talks

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| <i>Scalable Modeling and Inference for Phylogenetics</i> -from Interlocus Gene Conversion to Evolving Pathogens | Tulane University | 12/04/2019 |
| <i>Scalable Modeling and Inference for Phylogenetics</i> -from Interlocus Gene Conversion to Evolving Pathogens | Louisiana State University | 11/04/2019 |
| <i>Large-scale molecular epidemiology for viruses</i> | UCLA | 11/08/2018 |
| <i>Phylogenetic approaches for quantifying interlocus gene conversion</i> | Zhejiang University | 09/18/2018 |
| <i>Phylogenetic approaches for quantifying interlocus gene conversion</i> | Chinese Academy of Sciences | 09/04/2018 |
| <i>Phylogenetic approaches for quantifying interlocus gene conversion</i> | CGM online | 05/30/2018 |
| <i>Phylogenetic approaches for quantifying interlocus gene conversion</i> | Duke University | 02/15/2018 |
| <i>Phylogenetic approaches for quantifying interlocus gene conversion</i> | Temple University | 04/25/2017 |
| <i>Phylogenetic approaches for quantifying interlocus gene conversion</i> | N.C. State University | 03/24/2017 |

Funding

My dissertation project leads to an NSF grant award (DEB 1754142)

¹ SISMID: Summer Institute in Statistics and Modeling in Infectious Diseases at University of Washington at Seattle

² The funds were matched through North Carolina State University

³ SAMSI: The Statistical and Applied Mathematical Sciences Institute

⁴ SISG: Summer Institute in Statistical Genetics at University of Washington at Seattle

Software

- My software for studying interlocus gene conversion is freely available at <https://github.com/xji3/IGCexpansion>.
- A tutorial for the Bayesian method (under development) of quantifying interlocus gene conversion in BEAST is available at https://github.com/xji3/IGC_BEAST_Tutorial
- I'm a developer of the BEAST (<https://github.com/beast-dev/beast-mcmc>) software and the BEAGLE (<https://github.com/beagle-dev/beagle-lib>) library.
- I collaborate with a group of statisticians and programmers to help them use my linear-time gradient algorithm implementations for their variational Bayesian phylogenetics development at <https://github.com/phylovi/libsbm>.

Synergistic Activities

Professional service

- I have reviewed manuscripts for *Molecular Biology and Evolution*, *Annals of Applied Statistics*, *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, and *Evolutionary Bioinformatics*.

Outreach

- I served as treasurer on the ASSIST⁵ student leadership council in 2012 and 2013. I participated in the Magnet Fair at South Raleigh Magnet High School as an ASSIST center graduate representative in 2012.

⁵ ASSIST: The Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies