

# I-Ping Tu

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## Personal Statement

My research has mainly focused on developing statistical methods to analyze cryo-electron microscopy (cryo-EM) image data. In recent years, technical breakthrough has transformed cryo-EM to become a main tool for determination of molecular structure to atomic resolution without crystals or in solution. However, the process of structural determination from single-particle cryo-EM images is still very challenging because it involves processing extremely noisy images of unknown orientation. We have developed dimension reduction and clustering algorithms for highly noise image data. We will continue exploring statistical machine learning methods to improve the analysis.

## Research Areas

Clustering Analysis, Dimension Reduction, Scan Statistics, Statistical Machine learning, cryo-EM Image Analysis, Block Chain.

## Education

9/92--6/97      **Ph.D. in Statistics**, Stanford University  
9/89--6/91      **M.S. in Physics**, National Taiwan University  
9/85--6/89      **B.S. in Physics**, National Taiwan University

## Professional Experiences

Jul. 2017 ~ present      Deputy Director, The Institute of Statistical Science, Academia Sinica  
May. 2013 ~ present      Research Fellow, The Institute of Statistical Science, Academia Sinica  
Aug. 2003 ~ May. 2013      Associate Research Fellow, The Institute of Statistical Sciences, Academia Sinica  
Sep. 2002~Jul. 2003      Senior Statistician, The Stanford Functional Genomics Facility, Stanford University  
Mar. 2001~Aug. 2002      Statistician, The Stanford Functional Genomics Facility, Stanford University  
Aug. 1997~Jul. 2000      Postdoctoral Fellow, The Department of Health Research and Policy, Stanford University

## Honor

2013 Young Scholar Grant Award from Ministry of Science and Technology, Taiwan.  
2017-8 Grand Challenge Seed Grant for Data Science, Academia Sinica.  
2019-2020 Grand Challenge Seed Grant, Academia Sinica.

2019 ISI Elected member.

2020 ICCM Best Paper Award (Silver Award).

## Professional Service

2011-2013, Nomination and Election Committee for International Chinese Statistical Association (ICSA).

2016-2018, Executive Member of the Council for The Chinese Institute of Probability and Statistics.

2017-2020, A.E. of Statistica Sinica

2017-2019, Program Affair Council, The Data Science Program of National Taiwan University and Academia Sinica.

2018-2022, Member of the Editorial Board of International Statistical Review

2019-2021, Routine Supervisor for The Chinese Institute of Probability and Statistics.

## Teaching

Statistics, National Taiwan University, Taiwan, Spring 2009.

Regression Analysis, National Chiao Tung University, Taiwan, Fall 2010.

Statistical and Machine Learning, National Taiwan University, Fall, 2013.

Statistical and Machine Learning, National Taiwan University, Spring, 2016.

Statistics Foundation for Data Science, National Taiwan University, Fall, 2018.

Statistics Foundation for Data Science, National Taiwan University, Fall, 2019.

Seminar for Data Science, National Taiwan University, Fall, 2019; Spring, 2019; Fall, 2018; Spring, 2018; Fall, 2017.

## Complete Publication List

*\*refers to the corresponding author.*

### Journal Papers

1. Shao-Hsuan Wang, Yi-Ching Yao, Wei-Hau Chang and I-Ping Tu\* (2020). "Quantification of model bias underlying the phenomenon of Einstein from Noise". *Statistica Sinica (accepted)*. DOI: 10.5705/ss.202020.0334.
2. Szu-Chi Chung, Shao-Hsuan Wang, Po-Yao Niu, Su-Yun Huang, Wei-Hau Chang and I-Ping Tu\* (2020). "Two-stage dimension reduction for noisy high-dimensional images and application to Cryogenic Electron Microscopy". *Annals of Mathematical Sciences and Applications* **5**, 283-316.
3. Szu-Chi Chung, Hsin-Hung Lin, Po-Yao Niu, Shih-Hsin Huang, I-Ping Tu\* and Wei-Hau Chang\* (2020). "Pre-pro is a fast pre-processor for single-particle cryo-EM by enhancing 2D classification". *Communications Biology* **3**.
4. Ren Chen, I-Ping Tu, Kai-Er Chuang, Qin-Xue Lin, Shih-Wei Liao, Wanjiun Lia\* (2020). "Endex: Degree of mining power decentralization for proof-of-work based blockchain systems". *IEEE*

*Network* **34**, 266-271.

5. I-Ping Tu\*, Su-Yun Huang and Dai-Ni Hsieh (2019). "The generalized degrees of freedom of multilinear principal component analysis". *Journal of Multivariate Analysis* **173**, 26-37.
6. Jheng-Syong Wu, Cheng-Yu Hung, Tzu-yun Chen, Sam Song-yao Lin, Shu-Yu Lin, I-Ping Tu, Hung-Ta Chen and Wei-Hau Chang\* (2019). "Deriving a sub-nanomolar affinity peptide from TAP to enable smFRET analysis of RNA polymerase II complexes". *Methods* **159-160**, 59-69.
7. Ting-Li Chen, Dai-Ni Hsieh, Hung Hung, I-Ping Tu\*, Pei-Shien Wu, Yi-MingWu, Wei-Hau Chang and Su-Yun Huang (2014). "γ-SUP: a clustering algorithm for cryo-electron microscopy". *Annals of Applied Statistics* **8**, 259-285.
8. Ting-Li Chen, Su-Yun Huang\*, Hung Hung and I-Ping Tu (2014). "Introduction to multilinear principal component analysis". *JCSA* **52**, 24-43.
9. I-Ping Tu\*, Shao-Hsuan Wang and Yuan-Fu Huang (2013). "Estimating the Occurrence Rate of DNA Palindromes". *Annals of Applied Statistics* **7**, 1095-1110.
10. I-Ping Tu (2013). "The Maximum of a Ratchet Scanning Process over a Poisson Random Field". *Statistica Sinica* **23**, 1541-1551.
11. Hung Hung, Pei-Hsien Wu, I-Ping Tu\* and Su-Yun Huang (2012). "On multilinear principal component analysis of order-two tensors". *Biometrika* **99**, 569-583.
12. Hao-Chih Lee, Bo-Lin Lin, Wei-Hau Chang and I-Ping Tu\* (2012). "Towards Automated De-Noising of Single Molecular FRET Data: ADN for smFRET". *Journal of Biomedical Optics* **17**.
13. Hock Peng Chan\* and I-Ping Tu (2011). "Log-linear, Logistic Model Fitting and Local Score Statistics for Cluster Detection with Covariate Adjustments". *Statistics in Medicine* **30**, 91-100.
14. Wei-Hau Chang\*, Michael T.-K. Chiu, Chin-Yu Chen, Chi-Fu Yen, Yen-Cheng Lin, Yi-Ping Weng, Ji-Chau Chang, Yi-Min Wu, Holland Cheng, Jianhua Fu, and I-Ping Tu (2010). "Zernike phase plate cryo-electron microscopy facilitates single particle analysis of unstained asymmetric protein complexes". *Structure* **18**, 17-27.
15. Ying-Ping Chen, Hsin-Cheng Huang, and I-Ping Tu (2010). "A New Approach for Selecting the Number of Factors". *Computational Statistics and Data Analysis* **54**, 2990-2998.
16. Hock Peng Chan\*, I-Ping Tu and Nancy Zhang (2009). "Boundary crossing probability computations in the analysis of scan statistics" in *Scan Statistics--Theory and Applications*, eds J. Glaz and V. Pozdnyakov and S. Wallenstein, Birkhauser.
17. I-Ping Tu\*, Hung Chen and Xin Chen (2009). "An Eigenvector Variability Plot" *Statistica Sinica* **19**, 1741-1754.
18. I-Ping Tu\* (2009). "Asymptotic Overshoot for Arithmetic IID Random Variables", *Statistica Sinica* **19**, 315-323.
19. Suet Yi Leung, Coral Ho, I-Ping Tu, Rui Li, Samuel So, Kent-Man Chu, Siu Tsan Yuen and Xin Chen\* (2006). "Comprehensive analysis of 19q12 amplicon in human gastric cancers". *Modern pathology* **19**, 854-63.

20. I-Ping Tu, Marci Schaner, Maximilian Diehn, Branimir I. Sikic, Patrick O. Brown, David Botstein and Mike Fero\* (2004). "A Method for Detecting and Correcting Feature Misidentification on Expression Microarrays". *BMC Genomics* **6**, 54.
21. Marci E. Schaner, Douglas T. Ross, Giuseppe Ciaravino, Therese Sørli, Olga Troyanskaya, Maximilian Diehn, Yan C. Wang, George E. Duran, Thomas L. Sikic, Sandra Caldeira, Hanne Skomedal, I-Ping Tu, Tina Hernandez-Boussard, Steven W. Johnson, Peter J. O'Dwyer, Michael J. Fero, Gunnar B. Kristensen, Anne-Lise Børresen-Dale, Trevor Hastie, Robert Tibshirani, Matt van de Rijn, Nelson N. Teng, Teri A. Longacre, David Botstein, Patrick O. Brown, and Branimir I. Sikic\* (2003). Gene Expression Patterns in Ovarian Carcinomas. *Mol. Biol. Cell* **14**, 4376-4386.
22. Suet Ti Leung, Xin Chen, Kent M. Chu, Siu T. Yuen, Jonathan Mathy, Jiafu Ji, Annie S.Y. Chan, Rui Li, Simon Law, Olga G. Troyanskaya, I-Ping Tu, John Wong, Samuel So, David Botstein and Patrick O. Brown\* (2002). "Phospholipase A2, Group IIA expression in gastric adenocarcinoma is associated with prolonged survival and less frequent metastasis". *Proc Natl Acad Sci* **99**, 16203-8.
23. Alice Whittemore\*, I-Ping Tu (2000). "Detecting Disease Genes using Family Data. I. Likelihood-base Theory". *American Journal of Human Genetics* **66**, 1328-1340.
24. I-Ping Tu, Balise RR, Alice Whittemore\* (2000). "Detecting Disease Genes using Family Data. II. Application to nuclear families". *American Journal of Human Genetics* **66**, 1341-1350.
25. I-Ping Tu and David Siegmund\* (1999). "The Maximum of a Function of a Markov Chain and Application to Linkage Analysis" *Advances in Applied Probability* **31**, 510-531.
26. I-Ping Tu and Alice Whittemore\* (1999). "Power of Association and Linkage Tests when the Disease Alleles are Unobserved". *American Journal of Human Genetics*, **64**, 641-649.
27. Alice Whittemore\* and I-Ping Tu (1998). "Simple Robust Linkage Tests for Affected Sibs". *American Journal of Human Genetics* **62**, 1228-1242.
28. I-Ping Tu (1997). "Theory and Applications of Scan Statistics". *Stanford Technical Report*.
29. R. S. Pruthi, Iain Johnstone and I-Ping Tu, T. A. Stamey\* (1997). "Prostate-specific antigen doubling times in patients who have failed radical prostatectomy : Correlation with histologic characteristics of the primary cancer". *Urology* **49**, 737-742.
30. Yi-Chen Cheng\* and I-Ping Tu (1992). "Relation between the dielectric function and the density response function for metals with a surface". *Physical Review B (Condensed Matter)* **45**, 1386-1390.

### **Papers under review**

31. Shao-Hsuan Wang, Yi-Ching Yao, Wei-Hau Chang and I-Ping Tu\* (2020). "Quantification of model bias underlying the phenomenon of Einstein from Noise". *Statistica Sinica*, (under minor revision).
32. Tze Leung Lai, Shao-Hsuan Wang, Yi-Ching Yao, Szu-Chi Chung, Wei-Hau Chang, and I-Ping Tu\* (2020). "Cryo-EM: Breakthroughs in Chemistry, Structural Biology, and Statistical Underpinnings" (submitted).

### **Conference Papers**

1. Yu-Jing Lin, Po-Wei Wu, Cheng-Han Hsu, I-Ping Tu and Shih-Wei Liao (2019). An Evaluation of Bitcoin Address. Classification based on Transaction History Summarization. In *2019 IEEE International Conference on Blockchain and Cryptocurrency (ICBC)*, 302-310.
2. Chi-Ning Chou, Yu-Jing Lin, I-Ping Tu and Shih-Wei Liao (2018). Personalized Difficulty Adjustment for Countering the Double-Spending Attack in Proof-of-Work Consensus Protocols. In *2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData)*, 1456-1462.