Szu Chi **Chung**

Assistant Professor

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"If you can imagine it, you can achieve it. If you can dream it, you can become it."

Interests

I am an assistant professor at the Department of Applied Mathematics, National Sun Yat-sen University. Have received Ph.D. degree from National Chiao Tung University in Sep. 2017. I was a Postdoctoral research fellow from 2017 to 2021 at Institute of Statistical Science, Academia Sinica. I am interested in the area of data analysis and data security, including but not limited to:

Field	Machine learning, Clustering analysis and dimensional reduction, Cryo-EM and medical image analysis, Side-channel analysis, Security system design
Skill	Software programming (Python, Java, C, C++, CUDA), Big data framework (Spark, Hadoop), FPGA prototyping and hardware design

Education

PH.D. IN INSTITUTE OF ELECTRONICS — Sep. 2011 - Sep. 2017
National Chiao Tung University, Hsinchu, Taiwan.
- Research Group: Star group of Silicon implementation lab (SI2)
- Advisor: Chen-Yi Lee
- Thesis topic: Stream Cipher and ID-Based Crypto Systems for IoT Applications
- GPA 4.3/4.3, 34 credits

BS IN EECS UNDERGRADUATE HONORS PROGRAM — Sep. 2007 - Jun. 2011
National Chiao Tung University, Hsinchu, Taiwan.
- GPA 4.3/4.3, 159 credits

EXCHANGE STUDENT IN EECS — Aug. 2010 - DEC. 2010
University of Illinois Urbana-Champaign, USA
- GPA 4.0/4.0, 13 credits

HIGH SCHOOL GRADUATION — Sep. 2004 - Jun. 2007
National Hualien High School, Taiwan

Honors & Awards

2022	**Representative speaker of CSA**, 2022 JSS-KSS-CSA International Statistical Symposium	*Chinese Statistical Association (Taiwan)*
2020	**Best Paper Silver Award**, 2020 ICCM Best Paper Silver Award	*International Congress of Chinese Mathematicians*
2020	**Participants**, Global Young Scientists Summit	*National Research Foundation, Singapore*
2019	**Third Place**, Poster Competition of Institute of Statistical Science	*Academia Sinica*
2016	**Dragon Gate Program Scholarship (科技部龍門計畫)**, Visiting Student Researcher to Stanford University	*Ministry Of Science and Technology*
2013	**Second Prize**, IE Design Contest, Core Technology Category (教育部 IE 競賽)	*Ministry Of Education*
2012	**Bronze Medal Award**, 12th Macronix Golden Silicon Award	*Macronix Inc.*
2012	**First Prize**, IC Design Contest, Cell-Based IC Category (教育部 IC 競賽)	*Ministry Of Education*
2010	**EECS Study Aboard Scholarship**, Exchange student program to University of Illinois Urban-Champaign	*National Chiao Tung University*

Academic and Working Experiences

ASSISTANT PROFESSOR Aug. 2021 - PRESENT
Department of Applied Mathematics, National Sun Yat-sen University, Taiwan.

POSTDOCTORAL RESEARCHER Dec. 2017 - July 2021
Institute of Statistical Science, Academia Sinica, Taiwan.
- Laboratory Director: I-Ping Tu
- Research Group: Statistical Analysis for Biological Image Data

POSTDOC SEMINARS HOST Aug. 2018 - Jan. 2019
Institute of Statistical Science, Academia Sinica, Taiwan.
- Website: Postdoc Seminars

POSTDOCTORAL RESEARCHER Oct. 2017 - Nov. 2017
Institute of Electronics, National Chiao Tung University, Taiwan.
- Laboratory Director: Chen-Yi Lee
- Research Group: Security for Trust And Reliability Group

VISITING STUDENT RESEARCHER Nov. 2016 - Aug. 2017
Department of Statistics, Stanford University, USA.
- Advisor: Wing-Hung Wong
- Collaborator: Tung-Yu Wu

TEACHING ASSISTANT Fall 2015
National Chiao Tung University, Taiwan.
- Course: Introduction to VLSI Design
- Lecturer: Chen-Yi Lee

TEACHING ASSISTANT Fall 2011, Fall 2013 and Fall 2014
National Chiao Tung University, Taiwan.
- Course: Integrated Circuit Design Laboratory
- Lecturer: Chen-Yi Lee and Shyh-Jye Jou

TEACHING ASSISTANT Fall 2014
National Chiao Tung University, Taiwan.
- Course: Digital Circuit and System
- Lecturer: Chen-Yi Lee

TEACHING ASSISTANT 2010-2014
National Chiao Tung University, Taiwan.
- Course: Electronics Laboratory (I) and (II)
- Lecturer: Meng-Wei Wang

TEACHING ASSISTANT 2012
National Chiao Tung University, Taiwan.
- Course: Digital Circuit Laboratory
- Lecturer: Chien Chen

Dissertation

- Szu-Chi Chung, "Stream Cipher and ID-Based Crypto Systems for IoT Applications", *PhD dissertation*, (2017).

Academic Services

2021-2022 **Reviewer**, IEEE Transactions on Multimedia
2016-2017 **Reviewer**, IEEE Transactions on Circuits and Systems I (TCAS-I)
2016-2017 **Reviewer** , IEEE Transactions on Very Large Scale Integration Systems (TVLSI)
2016 **Reviewer**, IEEE Transactions on Computers

Research Projects

CRYO-EM AND MEDICAL IMAGE PROCESSING Dec. 2017 - PRESENT

Academia Sinica, Taiwan

- Develop dimension reduction and clustering methods
- Accelerate clustering and alignment methods for cryo-EM
- Develop a unified platform for integrating different cryo-EM packages (Collaborating with Scipion team)

NOVATEK-NCTU SIDE-CHANNEL ANALYSIS PROJECT Jan. 2019 - PRESENT

Novatek Microelectronics, Taiwan

- Developing side-channel countermeasure for SM2/SM4 circuits
- Examining side-channel leakage using hypothesis testing

SCALABLE VIDEO ANALYSIS FRAMEWORK Nov. 2016 - Sep. 2017

Stanford, USA

- Bridging the gap between distributed computation framework and traditional computer vision modules
- Provides a solution to deal with distributed video/image analysis in big data framework

BIG DATA SECURITY PROJECT Sep. 2014 - Sep. 2017

Ministry of Science and Technology, Taiwan

- Develop several high throughput Bilinear Pairing modules to support cloud security protocols
- Propose guidelines to design security modules for big data system

DELTA-NCTU IOT PROJECT Mar. 2014 - Mar. 2016

Delta Inc., Taiwan

- Develop stream ciphers that are suited to IoT scenario
- Design several implementation attacks and countermeasures
- Conduct side-channel attacks on the embedded system

E-HOME PROJECT Aug. 2011 - Jun. 2014

National Science Council, Taiwan

- Develop AES and ECC modules that are suited for IoT use
- Integrate with other submodules including computer vision, wireless and memory modules

Invited Talks

- 2022/10/18, "A framework for orientation recovery with uncertainty measure with the application in cryo-EM image analysis", *Seminar of Graduate Institute of Statistics in NCU* , (2022).
- 2022/09/06, "Contrastive and self-supervise learning for Cryo-EM image analysis", *2022 JSS-KSS-CSA International Statistical Symposium* , (2022).
- 2022/08/24, "Cryo-RALIB: A Modular Library for Accelerating Alignment in Cryo-EM", *OpenACC and Hackathons Asia-Pacific Summit* , (2022).
- 2022/06/06, "Contrastive modeling for Cryo-EM 3D orientation estimations", *The 5th International Conference on Econometrics and Statistics (EcoSta 2022)* , (2022).
- 2021/12/24, "Robust and rapid statistical learning method for Cryo-EM 3D conformation analysis", *Seminar of Institute of Statistics in NTHU* , (2021).
- 2021/11/24, "A Rapid and Robust Network-Based Approach to Reveal the 3D Discrete Conformations of Protein Using Cryo-EM", *Seminar of Institute of Statistics in NUK* , (2021).
- 2021/11/08, "Cryo-RALIB: A Modular Library for Accelerating Alignment in Cryo-EM", *GPU Technology Conference 2021* , (2021).
- 2021/10/14, "Discovering the Dynamics - Grouping 3D Structure Conformations Using Network Analysis on 2D Cryogenic Electron Microscopy (Cryo-EM) Projection Images", *Seminar of Department of Mathematics in NCKU* , (2021).
- 2021/05/06, "Grouping 3D Structure Conformations Using Network Analysis on 2D Cryogenic Electron Microscopy (Cryo-EM) Projection Images", *Seminar of Institute of Statistics in NYCU* , (2021).

- 2021/04/09, "Introduction to 3D conformation analysis - Eigen-analysis, 3DVA and AlphaCryo4D", *Workshop on Statistical Methods and Cryo-EM Data Analysis* , (2021).
- 2021/04/08, "Introduction to cryo-EM image processing - ASCEP and network conformation analysis", *Workshop on Statistical Methods and Cryo-EM Data Analysis* , (2021).
- 2021/03/20, "Toward computational conformation analysis of protein structure using Cryogenic Electron Microscopy (Cryo-EM)", *Statistical Conference in NCU* , (2021).
- 2021/03/17, "From snapshots to dynamic movies –toward computational conformation analysis of protein structure using Cryogenic Electron Microscopy (Cryo-EM)", *Seminar of NTHU ISA* , (2021).
- 2020/12/14, "Dimension reduction and clustering method for noisy high-dimensional images and application to Cryogenic Electron Microscopy", *NCTS Optimization Day for Young Researchers* , (2020).
- 2020/12/12, "Two-stage dimension reduction method and application to Cryogenic Electron Microscopy", *Waseda University-Academia Sinica joint workshop* , (2020).
- 2020/10/08, "Accelerated Cryo-EM Workflow", *GPU Technology Conference 2020* , (2020).
- 2019/12/27, "ASCEP - A Speedy and robust Cryo-EM processing Platform", *2019 Symposium On Statistical Analysis For Molecular Imaging And Biorhythms* , (2019).
- 2018/12/11, "A Dimension Reduction Method For Cryo-EM Image Processing", *2018 Workshop On High Dimensional Statistical Analysis* , (2018).
- 2018/03/14, "Scalable Video Analysis Framework", *Postdoc Seminars* , (2018).

Journal Paper

- I-Ping Tu, Yi-Ching Yao, Szu-Chi Chung, Shao-Hsuan Wang, Tze Leung Lai, "Uncertainty quantification in dynamic image reconstruction with applications to cryo-EM", *Accepted by Statistica Sinica* , (2022).
- Wei-Hau Chang, Shih-Hsin Huang, Hsin-Hung Lin, Szu-Chi Chung, I-Ping Tu, "Cryo-EM analyses permit visualization of structural polymorphism of biological macromolecules", *Frontiers in Bioinformatics* **74**, (2021).
- Wei-Hau Chang, Hsin-Hung Lin, I-Kuen Tsai, Shih-Hsin Huang , Szu-Chi Chung, I-Ping Tu, Steve Yu, Sunney I. Chan, "Copper Centers in the Cryo-EM Structure of Particulate Methane Monooxygenase Reveal the Catalytic Machinery of Methane Oxidation", *Journal of the American Chemical Society* **143**, (2021).
- Szu-Chi Chung, Shao-Hsuan Wang, Po-Yao Niu, Su-Yun Huang, Wei-Hau Chang, I-Ping Tu, "Two-stage dimension reduction for noisy high-dimensional images and application to Cryogenic Electron Microscopy", *Annals of Mathematical Sciences and Applications* **5**, (2020). (Receive 2020 ICCM Best Paper Silver Award).
- Szu-Chi Chung, Hsin-Hung Lin, Po-Yao Niu, Shih-Hsin Huang, I-Ping Tu, Wei-Hau Chang, "Pre-Pro is a Fast Pre-Processor for Single-Particle Cryo-EM by Enhancing 2D Classification", *Communications Biology* **3**, (2020).
- Szu-Chi Chung, Chun-Yuan Yu, Sung-Shine Lee, Hsie-Chia Chang, Chen-Yi Lee, "An Improved DPA Countermeasure Based on UDRPG for IoT Applications", *IEEE Transactions on Circuits and Systems I (TCAS-I)* **64**, 2522–2531 (2017).
- Szu-Chi Chung, Jing-Yu Wu, Hsing-Ping Fu, Jen-Wei Lee, Hsie-Chia Chang, Chen- Yi Lee, "Efficient Hardware Architecture of η_T Pairing Accelerator Over Characteristic Three", *IEEE Transactions on Very Large Scale Integration (VLSI) System* **23**, 88–97 (2015).

- Jen-Wei Lee, Szu-Chi Chung, Hsie-Chia Chang, Chen-Yi Lee, "Efficient Power-Analysis-Resistant Dual-Field Elliptic Curve Cryptographic Processor Using Heterogeneous Dual-Processing-Element Architecture", *IEEE Transactions on Very Large Scale Integration (VLSI) System* **22**, 49–61 (2014).

Conference Paper

- Szu-Chi Chung, Cheng-Yu Hung, Huei-Lun Siao, Hung-Yi Wu, Wei-Hau Chang, I-Ping Tu, "Cryo-RALib – a modular library for accelerating alignment in cryo-EM", *IEEE International Conference on Image Processing (ICIP)* , 225-229 (2021).
- Szu-Chi Chung, Shao-Hsuan Wang, Cheng-Yu Hung, Wei-Hau Chang, I-Ping Tu, "rAMI –Rapid Alignment with Moment of Inertia for Cryo-EM Image Processing", *Microscopy and Microanalysis 2021 Meeting* , (2021).
- Szu-Chi Chung, Hung-Yi Wu, Wei-Hau Chang, and I-Ping Tu, "Grouping 3D Structure Conformations using Network Analysis on 2D Cryo-EM Projection Images", *Focus on Microscopy 2021* , (2021).
- Szu-Chi Chung, Shao-Hsuan Wang, Po-Yao Niu, Su-Yun Huang, I-Ping Tu, Wei-Hau Chang, "Accelerated cryo-EM workflow", *The 29th South Taiwan Statistics Conference* , (2020).
- Szu-Chi Chung,Po-Yao Niu, Su-Yun Huang, Wei-Hau Chang, I-Ping Tu, "A Two-Stage Dimension Reduction Method For Cryo-EM Image Processing", *Microscopy and Microanalysis 2019 Meeting* , (2019).
- Szu-Chi Chung, Po-Yao Niu, Su-Yun Huang, Wei-Hau Chang, I-Ping Tu, "A Dimension Reduction Method for cryo-EM Image Analysis", *The 27th South Taiwan Statistics Conference* , (2018).
- Sung-Shine Lee, Szu-Chi Chung, Chun-Yuan Yu, Hsie-Chia Chang, Chen-Yi Lee, "A New Power Analysis Attack on Stream cipher Trivium-64", *VLSI Design/CAD Symposium (VLSI-CAD)* , (2015). Details.
- Szu-Chi Chung, Sung-Shine Lee, Hsie-Chia Chang, Chen-Yi Lee , "Implementing Bilinear Pairing Accelerator Using Residue Number System", *VLSI Design/CAD Symposium (VLSI-CAD)* , (2014).
- Jen-Wei Lee, Szu-Chi Chung, Hsie-Chia Chang, Chen-Yi Lee, "A $3.40ms/GF(p_{521})$ and $2.77ms/GF(2^{521})$ DF-ECC Processor with Side-Channel Attack Resistance", *IEEE International Solid-State Circuits Conference (ISSCC)* , 50–51 (2013).
- Jen-Wei Lee, Szu-Chi Chung, Hsie-Chia Chang, Chen-Yi Lee, "An Efficient Countermeasure against Correlation Power-Analysis Attacks with Randomized Montgomery Operations for DF-ECC Processor", *Conference on Cryptographic Hardware and Embedded Systems (CHES)* , 548–564 (2012).
- Szu-Chi Chung, Jen-Wei Lee, Hsie-Chia Chang, Chen-Yi Lee, "High-performance elliptic curve cryptographic processor over $GF(p)$ with SPA resistance", *IEEE International Symposium on Circuits and Systems (ISCAS)* , 1456–1459 (2012).

Preprints

- Szu-Chi Chung, Hisn-Hung Lin, Kuen-Phon Wu, Ting-Li Chen, Wei-Hau Chang, and I-Ping Tu, "RE2DC: a robust and efficient 2D classifier with visualization tool for rapid processing massive and heterogeneous cryo-EM data", *https://www.biorxiv.org/content/10.1101/2022.11.21.517443v2* , (2022).
- Tze Leung Lai, Shao-Hsuan Wang, Yi-Ching Yao, Szu-Chi Chung, Wei-Hau Chang, and I-Ping Tu, "Cryo-EM: Breakthroughs in Chemistry, Structural Biology, and Statistical Underpinnings", *submitted to Statistical Science* , (2022).

Patents

2019	**Cracking devices and methods thereof**, 10277392	*US Patent*
2019	**Encryption/decryption apparatus and power analysis protecting method thereof**, 10326586	*US Patent*

References

Dr. I-Ping Tu
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