# Fan-Keng Sun

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## Research Interests

Machine learning and deep learning for time series.

## Education

**Massachusetts Institute of Technology (MIT)** *Cambridge, MA*
Ph.D. in Electrical Engineering and Computer Science *09/2019 - PRESENT*

- Courses: Machine Learning, Algorithms for Inference, Advanced Natural Language Processing, Optimization Methods
- GPA: 5.0/5.0

**National Taiwan University (NTU)** *Taipei, Taiwan*
B.S. in Electrical Engineering (major) and Computer Science (minor) *09/2014 - 06/2019*

- GPA: 3.96/4.00, Major GPA: 3.99/4.00

## Research Experiences

***Research Assistant*, Statistical Metrology Group**, Prof. Duane S. Boning *09/2019 - PRESENT*

*Time Series Forecasting*[**Ongoing**]

- Proposed a simple feed-forward network that is very effective in time series forecasting.

*Time Series Anomaly Detection [**Ongoing**]*

- Proposed fractional average pooling to achieve state-of-the-arts performance on high-frequency manufacturing time series datasets.

*Adapting to Concept Drift in Time Series [**Ongoing**]*

- Proposed a meta-learning-based framework that predicts future drift in the model.

*PCA-based Representation for Time Series [**Ongoing**]*

- Design a PCA-based representation for forecasting on small and cyclical time series data.

*Autocorrelated Errors in Time Series [**NeurIPS-21**]*

- Proposed a method to adjust for autocorrelated errors in neural networks for time series.
- Adding our method to existing state-of-the-art models improves performances across a wide range of tasks and datasets.

*Time Series for Semiconductor Manufacturing [**2 ×IEEE Trans. on Semicond. Manuf.**]*

***Applied Scientist Intern*, Amazon AWS Forecast**, Hilaf Hasson, Bernie Wang, Anoop Deoras *06/2021 - 09/2021*

*Long-term Time Series Forecasting [**In submission**]*

- Proposed a simple yet very effective model based in frequency domain that outperforms previous state-of-the-arts.

***Research Assistant*, Speech Processing and Machine Learning Lab**, Prof. Hung-yi Lee *09/2016 - 08/2019*

*Lifelong Language Learning [**ICLR-20**]*

- Proposed a method that trains a GPT-2 model with both question-answering and language model objectives to tackle the lifelong language learning problem.
- Outperformed previous methods by a large margin yet being simple and extensible.

*Multivariate Time Series (MTS) Forecasting [**Journal track of the ECML/PKDD-19**]*

- Proposed the temporal pattern attention for MTS forecasting, which use CNNs to extract temporal patterns across multiple time steps instead of a single time step as in traditional attention mechanisms.
- Achieved state-of-the-art performance on a wide range of MTS datasets, including polyphonic music notes.

*Reviewed paper for ICASSP 2019 and TASLP 2019*

***Research Assistant*, Electronic Design Automation Lab**, Prof. Yao-Wen Chang *02/2016 - 12/2018*

*Bivariate Gradient-based Wirelength Model [**DAC-19**]*

- Proposed a novel bivariate gradient-based wirelength model for global placement that combines the advantages of bivariate and multivariate functions.
- Outperformed previous bivariate and state-of-the-art multivariate wirelength models.

*Topology-Matching Bus Routing [**DAC-19**]*

- Proposed and implemented the DAG-based topology-matching bus routing engine and won the top 10 at 2018 ICCAD CAD contest.
- Outperformed all participants of 2018 ICCAD CAD contest, where the 1st place router resulted in 145% higher cost.

*Initial Detailed Routing [**ICCAD-18**]*

- Proposed the multithreaded initial detailed routing engine considering global guides and won the 3rd place at the 2018 ISPD contest.
- Outperformed the winner of 2018 ISPD contest by 23%.

***Undergraduate Researcher*, Speech Processing Lab**, Prof. Lin-shan Lee *09/2017 - 09/2018*

*Reinforcing Reinforcement Learning by Rule-based Teacher*

- Applied computer vision technique to guide a rule-based Slither.io agent.
- Researched the combination of a rule-based teacher to guide a Slither.io agent by Asynchronous Advantage Actor Critic (A3C) which surpassed rule-based model.

***Software Engineering Intern*, Synopsys, Inc.** *07/2016 - 08/2016*

*Single-Layer Global Routing*

- Researched and implemented a single-layer global routing algorithm based on a mixture of previous literature and own design.

## Publications

(* indicates equal contribution)

1. Rachel Owens, **Fan-Keng Sun**, Christopher Venditti, Daniel Blake, Jack Dillon, Duane Boning. Dynamic Time Warping Constraints for Semiconductor Processing. In *Advanced Semiconductor Manufacturing Conference (ASMC)*, 2024.
2. Zhengqi Gao, **Fan-Keng Sun**, Duane S Boning. KirchhoffNet: A Circuit Bridging Message Passing and Continuous-Depth Models. In *arXiv*, 2023.
3. Chih-Yu Lai, **Fan-Keng Sun**, Zhengqi Gao, Jeffrey H. Lang, Duane S. Boning. Nominality Score Conditioned Time Series Anomaly Detection by Point/Sequential Reconstruction. In *Neural Information Processing Systems (NeurIPS)*, 2023.
4. **Fan-Keng Sun**, Duane S. Boning. FreDo: Frequency Domain-based Long-Term Time Series Forecasting. In *arXiv*, 2022.
5. Zhengqi Gao, **Fan-Keng Sun**, Mingran Yang, Sucheng Ren, Zikai Xiong, Marc Engeler, Antonio Burazer, Linda Wildling, Luca Daniel, Duane S. Boning. Learning from Multiple Annotator Noisy Labels via Sample-wise Label Fusion. In *ECCV*, 2021.
6. Christopher I Lang, **Fan-Keng Sun**, Bruce Lawler, Jack Dillon, Ash Al Dujaili, John Ruth, Peter Cardillo, Perry Alfred, Alan Bowers, Adrian McKiernan, Duane S. Boning. One Class Process Anomaly Detection Using Kernel Density Estimation Methods. *IEEE Transactions on Semiconductor Manufacturing*, 2022.
7. Christopher I. Lang, **Fan-Keng Sun**, Ramana Veerasingam, John Yamartino, Duane S. Boning. Understanding and Improving Virtual Metrology Systems Using Bayesian Methods. *IEEE Transactions on Semiconductor Manufacturing*, 2022.
8. **Fan-Keng Sun**, Christopher I. Lang, Duane S. Boning. Adjusting for Autocorrelated Errors in Neural Networks for Time Series. In *Neural Information Processing Systems (NeurIPS)*, 2021.
9. Kyongmin Yeo, Dylan E. C. Grullon, **Fan-Keng Sun**, Duane S. Boning, Jayant R. Kalagnanam. Variational inference formulation for a model-free simulation of a dynamical system with unknown parameters by a recurrent neural network. *SIAM Journal on Scientific Computing (SISC)*, 2021.
10. **Fan-Keng Sun**, Cheng-I Lai. Conditioned natural language generation using only unconditioned language model: An exploration. In *arXiv*, 2020.
11. **Fan-Keng Sun***, Cheng-Hao Ho*, Hung-yi Lee. LAMOL: LAnguage MOdeling for Lifelong Language Learning. In *International Conference on Learning Representations (ICLR)*, 2020.
12. Chen-Hao Hsu, Shao-Chun Hung, Hao Chen, **Fan-Keng Sun**, Yao-Wen Chang. A DAG-Based Algorithm for Obstacle-Aware Topology-Matching On-Track Bus Routing. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, 2020.
13. Shun-Yao Shih*, **Fan-Keng Sun***, Hung-yi Lee. Temporal Pattern Attention for Multivariate Time Series Forecasting. Journal track of the *European Conference on Machine Learning & Principles and Practice of Knowledge Discovery in Databases (ECML/PKDD)*, 2019.
14. **Fan-Keng Sun**, Yao-Wen Chang. BiG: A Bivariate Gradient-Based Wirelength Model for Analytical Circuit Placement. In *Proc. of ACM/IEEE Design Automation Conference (DAC)*, 2019.
15. Chen-Hao Hsu, Shao-Chun Hung, Hao Chen, **Fan-Keng Sun**, Yao-Wen Chang. A DAG-Based Algorithm for Obstacle-Aware Topology-Matching On-Track Bus Routing. In *Proc. of ACM/IEEE Design Automation Conference (DAC)*, 2019.
16. **Fan-Keng Sun**, Hao Chen, Ching-Yu Chen, Chen-Hao Hsu, Yao-Wen Chang. A Multithreaded Initial Detailed Routing Algorithm Considering Global Routing Guides. In *Proc. of IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, 2018.

## Teachings

***Teaching Assistant*, Algorithm Design and Analysis (Fall 2018)**, Prof. Yun-Nung Chen & Hsu-Chun Hsiao *09/2018 - 01/2019*
***Teaching Assistant*, Machine Learning and Having It Deep and Structured (Spring 2018)**, Prof. Hung-yi Lee *02/2018 - 06/2018*
***Teaching Assistant*, Machine Learning (Fall 2017)**, Prof. Hung-yi Lee *09/2017 - 01/2018*
***Teaching Assistant*, Statistical Data Analysis (Spring 2023)**, Prof. Devavrat Shah & Prof. Yury Polyanskiy *02/2023 - 06/2023*

## Honors & Awards

2019 **AI Research Grant (with Prof. Hung-yi Lee)**, Salesforce
2018 **Outstanding Performance Scholarship**, National Taiwan University
2018 **3rd Place (first pure-undergraduate team in the top 3 in 14 years)**, ISPD Contest
2017 **National Technology and Science Scholarship**, CTCI Foundation
2017 **3rd Place**, National Collegiate Programming Contest
2017 **Silver Medal**, ACM ICPC Regional Contest
2016 **1st Place**, ACM ICPC Regional Contest
2016 **1st Place out of 2000 participants from 45 countries**, Calculus World Cup

## Skills

***Natural Languages*** Chinese (Mandarin), English, Taiwanese
***Programming Languages*** Python, C/C++, Java, R, SQL, Julia, Shell, Matlab, LaTeX, Git
***Deep Learning Libraries*** Tensorflow, PyTorch, Keras
***Web Scraping Libraries*** Beautiful Soup, Selenium, Scrapy