

# Fan-Keng Sun

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## Research Interests

Machine learning and deep learning for time series.

## Education

### Massachusetts Institute of Technology (MIT)

Ph.D. in Electrical Engineering and Computer Science

Cambridge, MA

09/2019 - PRESENT

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

### National Taiwan University (NTU)

B.S. in Electrical Engineering (major) and Computer Science (minor)

Taipei, Taiwan

09/2014 - 06/2019

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

## Research Experiences

### Research Assistant, Statistical Metrology Group, Prof. Duane Boning

09/2019 - PRESENT

*Time Series Forecasting [In submission]*

- Proposed a simple feed-forward network that is very effective on 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]*

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

*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. **Fan-Keng Sun**, Duane S Boning. FreDo: Frequency Domain-based Long-Term Time Series Forecasting. In *arXiv*, 2022.
2. 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.
3. 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.
4. Christopher I. Lang, **Fan-Keng Sun**, Ramana Veerasingham, John Yamartino, Duane S. Boning. Understanding and Improving Virtual Metrology Systems Using Bayesian Methods. *IEEE Transactions on Semiconductor Manufacturing*, 2022.
5. **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.
6. 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.
7. **Fan-Keng Sun**, Cheng-I Lai. Conditioned natural language generation using only unconditioned language model: An exploration. In *arXiv*, 2020.
8. **Fan-Keng Sun\***, Cheng-Hao Ho\*, Hung-yi Lee. LAMOL: LAnguage MOdeling for Lifelong Language Learning. In *International Conference on Learning Representations (ICLR)*, 2020.
9. 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.
10. 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.
11. **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.
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. In *Proc. of ACM/IEEE Design Automation Conference (DAC)*, 2019.
13. **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

<b>Teaching Assistant, Algorithm Design and Analysis (Fall 2018)</b> , Prof. Yun-Nung Chen & Hsu-Chun Hsiao	09/2018 - 01/2019
<b>Teaching Assistant, Machine Learning and Having It Deep and Structured (Spring 2018)</b> , Prof. Hung-yi Lee	02/2018 - 06/2018
<b>Teaching Assistant, Machine Learning (Fall 2017)</b> , Prof. Hung-yi Lee	09/2017 - 01/2018

## 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

## Extracurricular Activities

<b>Director, Academic Department of NTUEE Student Association</b>	09/2016 - 06/2017
<ul style="list-style-type: none"><li>• Led a team of over 30 students to provide <u>academic services</u> to the <u>700+ undergraduates</u>, including, but not limited to, the followings:</li><li>• EExplore: an event where professors introduce all research areas in EE department to freshmen.</li><li>• Lab Intro: a week of continuous lab introduction by the corresponding professor to recruit interested undergraduate researchers.</li></ul>	
<b>Chair, MakeNTU Makeathon</b> , [website], [FB fan page], [Recap video]	08/2016 - 02/2017
<ul style="list-style-type: none"><li>• Organized the <u>largest nationwide student Makeathon</u> in Taiwan with <u>200 participants</u>, <u>70k USD arrangement</u>, and <u>60 volunteers</u>.</li><li>• Collaborated with the <u>Taipei City</u> and <u>22 international companies</u>, including Google, Microsoft, Dell, TSMC, Intel, ARM, Asus, etc.</li></ul>	

## Skills

<b>Natural Languages</b>	Chinese (Mandarin), English, Taiwanese
<b>Programming Languages</b>	Python, C/C++, Java, R, SQL, Julia, Shell, Matlab, $\text{\LaTeX}$ , Git
<b>Deep Learning Libraries</b>	Tensorflow, PyTorch, Keras
<b>Web Scraping Libraries</b>	Beautiful Soup, Selenium, Scrapy