

# Yu-Chia Chen

PH.D. CANDIDATE AT THE UNIVERSITY OF WASHINGTON

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## Summary

|                              |  |
|------------------------------|--|
| <b>Research</b>              | Manifold learning, Geometric data analysis, Edge flow learning, Dynamic networks, Embedding                |
| <b>Affiliations</b>          | Facebook Inc., Institute for Pure and Applied Mathematics, Microsoft Corporation, University of Washington |
| <b>Programming Languages</b> | Python (Advanced), MATLAB (Advanced), JavaScript (Intermediate), C++ (Intermediate)                        |
| <b>Languages</b>             | English (Professional), Mandarin (Native), Taiwanese (Native)  |

## Education

### University of Washington

PH.D. IN ELECTRICAL ENGINEERING

- Advisor: Marina Meilă

Seattle, WA

Sep. 2016 - PRESENT

### National Taiwan University

B.S. IN PHYSICS

Taipei, Taiwan

Sep. 2011 - Jun. 2015

## Experience

### Geometric Data Analysis Group (prof. Marina Meilă), University of Washington

PH.D. STUDENT RESEARCHER

Seattle, WA

Apr. 2017 - PRESENT

- Thesis: "Learning Topological Structures and Vector Fields on Manifolds with (Higher-order) Discrete Laplacians"
  - Analyzed the decomposability of the  $k$ -th homology embedding (the higher-order generalization of spectral clustering) of the discrete  $k$ -Hodge Laplacian under matrix perturbation theory [8]
  - Proposed a versatile framework for topological feature discovery and semi-supervised edge flow learning from point cloud data [10]
  - Studied a well-known defect of spectral embedding methods on manifolds with large aspect ratios (NeurIPS'19 [1])
- Created a tutorial of manifold learning on molecular dynamics (MD) simulation data [11]
- Developed a scalable manifold learning python toolkit for millions of points named **megaman** (<https://github.com/mmp2/megaman>)

### Facebook

MACHINE LEARNING INTERN

Seattle, WA

Jun. 2020 - Sep. 2020

- Developed deep learning models to optimize the click-through rate (CTR) based recommendation system for search ads placement
- Investigated various modeling techniques including transfer learning and multi-task learning

### Microsoft Research

RESEARCH INTERN

Redmond, WA

Jun. 2018 - Sep. 2018

- Proposed a large scale dynamic network model, based on the stochastic block model (SBM), to study the system evolution (a time series of graphs)
- Obtained the maximum a posteriori (MAP) estimator by auto-grad, enabling the model to be fit on networks with millions of vertices
- Presented a sampling based extension to causal impact, allowing the practitioners to determine the significance of the intervention
- Paper [3] accepted to KDD 2019 research track (acceptance rate 14.2%)

## Publications

### REFERRED PUBLICATIONS

- [1] **YU-CHIA CHEN** and Marina Meilă. Selecting the independent coordinates of manifolds with large aspect ratios. In *Advances in Neural Information Processing Systems* 32, pages 1086–1095, 2019
- [2] Samson J. Koele, Hanyu Zhang, Marina Meilă and **YU-CHIA CHEN**. Manifold Coordinates with Physical Meaning. *Second Workshop on Machine Learning and the Physical Sciences (NeurIPS 2019)*, Vancouver, Canada, December, 2019
- [3] **YU-CHIA CHEN**, Avleen S. Bijral, and Juan Lavista Ferres. On Dynamic Network Models and Application to Causal Impact. In *Proceedings of the 25th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*, KDD '19, pages 1194–1204, New York, NY, USA, 2019. ACM
- [4] **YU-CHIA CHEN**, Dominique Perrault-Joncas, Marina Meilă, and James McQueen. Improved Graph Laplacian via Geometric Self-Consistency. *NIPS Workshop on NIPS Highlights (MLTrain)*, Learn How to code a paper with state of the art frameworks, Long Beach, CA, December 2017

- [5] Peifeng Jing, Kosuke Winston, **YU-CHIA CHEN**, Benjamin S. Freedman, and Lih Y. Lin. Patterning and Colonizing Stem Cells with Optical Trapping. In *Optics in the Life Sciences Congress (2017), Paper OtM4E.2*, page OtM4E.2. Optical Society of America, April 2017
- [6] **YU-CHIA CHEN**, Cih-Su Wang, Tsung-Yuan Chang, Tai-Yuan Lin, Hsiu-Mei Lin, and Yang-Fang Chen. Ultraviolet and visible random lasers assisted by diatom frustules. *Optics Express*, 23(12):16224–16231, June 2015
- [7] Cih-Su Wang, Chi-Shung Liao, Tzu-Ming Sun, **YU-CHIA CHEN**, Tai-Yuan Lin, and Yang-Fang Chen. Biologically inspired band-edge laser action from semiconductor with dipole-forbidden band-gap transition. *Scientific Reports*, 5:8965, March 2015

## PREPRINTS/UNDER REVIEW/TECHNICAL REPORTS

- [8] **YU-CHIA CHEN** and Marina Meilă. The decomposition of the higher-order homology embedding constructed from the k-Laplacian. *arXiv:2107.10970 [stat.ML]*, July 2021
- [9] Timothy Siegler, Wiley Dunlap-Shohl, Yuhuan Meng, Wylie Kau, Preetham Sunkari, Chang-En Tsai, Zachary Armstrong, **YU-CHIA CHEN**, David Beck, Marina Meila, and Hugh Hillhouse. Water-Accelerated Photo-oxidation of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> Perovskite: Mechanism, rate orders, and rate constants. *ChemRxiv*, June 2021
- [10] **YU-CHIA CHEN**, Marina Meilă, and Ioannis G. Kevrekidis. Helmholtzian Eigenmap: Topological feature discovery & edge flow learning from point cloud data. *arXiv:2103.07626 [stat.ML]*, March 2021
- [11] **YU-CHIA CHEN**, James McQueen, Samson J. Koelle, Marina Meilă, Stefan Chmiela and Alexandre Tkatchenko. Modern Manifold Learning Methods for MD data – a step by step procedural overview. <http://students.washington.edu/yuchaz/files/2020-md-manifold.pdf>
- [12] Samson J. Koelle, Hanyu Zhang, Marina Meilă and **YU-CHIA CHEN**. Manifold Coordinates with Physical Meaning. (Under review at JMLR)

## Other Experience & Course Projects

### Institute for Pure & Applied Mathematics (IPAM), UCLA

Los Angeles, CA

VISITING RESEARCHER

Sep. 2019 - Dec. 2019

- Participated in the *Machine Learning for Physics and the Physics of Learning* long program
- Investigated the plausible intersection of conformal prediction, unsupervised learning, and physical science
- White paper: <https://www.ipam.ucla.edu/news/white-paper-machine-learning-for-physics-and-the-physics-of-learning/>

### Department of Electrical & Computer Engineering, University of Washington

Seattle, WA

TEACHING ASSISTANT

Jan. 2017 - Dec. 2017

- Courses: Digital Signal Processing (graduate level), Devices And Circuits, Discrete Time Linear Systems, Fundamentals of Electrical Engineering

### Selfie Sensei: Convolutional Neural Network based selfie instructor

Seattle, WA

COURSE PROJECT

Apr. 2017 - Jun 2017

- Built and trained the Google Inception-v3 model on 40 thousand selfies collected from twitter with hashtag #selfie

### Large scale medical subject heading (MeSH) term indexing

Seattle, WA

COURSE PROJECT

Jan. 2017 - Mar. 2017

- Constructed a Convolutional Neural Network trained with *skipgram* word2vec embedding to annotate 27k MeSH terms on 12M academic articles

### Photonics Lab, University of Washington

Seattle, WA

GRADUATE RESEARCH ASSISTANT

Sep. 2016 - Dec. 2016

- Investigated high accuracy mass sensing using Nanostructure-enhanced laser tweezers and its application to stem cell patterning [5]

### Psychological Warfare Group, Ministry of National Defense

Taipei, Taiwan

FRONT-END SOFTWARE ENGINEER (COMPULSORY MILITARY SERVICE)

Aug. 2015 - Jul. 2016

- Lead engineer on cloud-based file exchanging platform, which enabled user to search, view and share streaming media
- Technology used: JavaScript (*react.js*), HTML/CSS

### Semiconductor Laboratory (prof. Yang-Fang Chen), National Taiwan University

Taipei, Taiwan

UNDERGRADUATE RESEARCHER

Feb. 2014 - Jun. 2015

- Investigated bio-photonics devices with wide spectrum range [6]
- Studied Perovskite and CdTe core shell quantum dots assisted random laser in bio-inspired materials [7]

## Honors & Awards

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|      |  |                   |
|------|--|-------------------|
| 2019 | <b>Student Travel Award</b> , NeurIPS 2019                               | Vancouver, Canada |
| 2019 | <b>Student Travel Award</b> , KDD 2019                                   | Anchorage, AK     |
| 2019 | <b>Travel Grant</b> , UW Department of Electrical & Computer Engineering | Seattle, WA       |
| 2013 | <b>Scholarship</b> , Taipower Academic Scholarship                       | Taipei, Taiwan    |
| 2012 | <b>Scholarship</b> , Taipower Academic Scholarship                       | Taipei, Taiwan    |
| 2010 | <b>Second prizes</b> , Physics Scholastic Ability Contest                | Kaohsiung, Taiwan |

## Selected Talks

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| Nov. 2020 | <b>Seminar Talk</b> , UW UW ML retreat, <i>Higher-order topological feature discovery and edge flow learning</i>            | Seattle, WA       |
| Feb. 2020 | <b>Seminar Talk</b> , UW Geometric Data Analysis Group, <i>Hodge Laplacians on graphs</i>                                   | Seattle, WA       |
| Dec. 2019 | <b>Poster Presentation</b> , NeurIPS'19, <i>Selecting the Independent Coordinates of Manifolds with Large Aspect Ratios</i> | Vancouver, Canada |
| Oct. 2019 | <b>Seminar Talk</b> , IPAM, <i>Selecting the Independent Coordinates of Manifolds with Large Aspect Ratios</i>              | Los Angeles, CA   |
| Aug. 2019 | <b>Poster Presentation</b> , KDD'19, <i>On Dynamic Network Models and Application to Causal Impact</i>                      | Anchorage, AK     |
| Sep. 2018 | <b>Seminar Talk</b> , Microsoft, <i>On Dynamic Network Models and Application to Causal Impact</i>                          | Redmond, WA       |
| Jan. 2018 | <b>Seminar Talk</b> , UW Geometric Data Analysis Group, <i>Improved Graph Laplacian via geometric self-consistency</i>      | Seattle, WA       |

## Coursework

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### UNIVERSITY OF WASHINGTON

**CSE 525** Randomized Algorithm; **EE 546** Learning and Game Theory; **STAT 512** Statistical Inference; **STAT 548** Machine Learning for Big Data; **STAT 538** Statistical Learning; **CSE 599** Interplay between Convex Optimization and Geometry; **MATH 515** Fundamental of Optimization; **EE 576** Computer Vision; **EE 595** Data Science for Sequencing; **CSE 517** Natural Language Processing; **EE 518** Digital Signal Processing

### NATIONAL TAIWAN UNIVERSITY (SELECTED)

**PHYS 8049** Introduction to Quantum Computation & Information; **PHYS 4001** Optics; **PHYS 3002** Group Theory; **PHYS 3001** Complex Analysis

## References

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### Marina Meilă

DEPARTMENT OF STATISTICS, UNIVERSITY OF WASHINGTON

[mmp@stat.washington.edu](mailto:mmp@stat.washington.edu)

### Avleen S. Bijral

MICROSOFT CORPORATION

[avbijral@microsoft.com](mailto:avbijral@microsoft.com)

### Les Atlas

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### Yang-Fang Chen

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