Yu-Chia **Chen**

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Summary

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

Education

University of Washington — *Seattle, WA*

Ph.D. in Electrical Engineering — *Sep. 2016 - PRESENT*

- Advisor: Marina Meilă

National Taiwan University — *Taipei, Taiwan*

B.S. in Physics — *Sep. 2011 - Jun. 2015*

Experience

Geometric Data Analysis Group (prof. Marina Meilă), University of Washington — *Seattle, WA*

Ph.D. Student Researcher — *Apr. 2017 - PRESENT*

- Proposed a versatile framework for topological feature discovery and semi-supervised edge flow learning from point cloud data [10]
  - Presented a triplet-wise similarity kernel resembling the VR complex in computational topology
  - Proved the consistency of the discrete 1-Laplacian to its continuous counterpart (Hodge Laplacian)
  - Applied the method on molecular dynamics, oceanology, and COVID-19 pandemic data to study the propagation of the flow
- Studied a well-known defect of spectral embedding methods on manifolds with large aspect ratios (NeurIPS'19 [1])
  - Provided an efficient criterion based subset selection algorithm to produce independent coordinates for smooth embedding
  - Showed that the criterion, based on the projected volume ratio of the chosen coordinates, asymptotically converged to a KL divergence
  - Discovered the meaningful embedding for the galaxy and molecular dynamics datasets
- 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 — *Seattle, WA*

Machine Learning Intern — *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 — *Redmond, WA*

Research Intern — *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. Koelle, 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 Liau, 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 CH3NH3PbI3 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*), HMTL/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

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

Selected Talks

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

Coursework

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

Marina Meilă

DEPARTMENT OF STATISTICS, UNIVERSITY OF WASHINGTON   *mmp@stat.washington.edu*

Avleen S. Bijral

MICROSOFT CORPORATION   *avbijral@microsoft.com*

Les Atlas

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Yang-Fang Chen

DEPARTMENT OF PHYSICS, NATIONAL TAIWAN UNIVERSITY   *yfchen@phys.ntu.edu.tw*