

KAIJUN WANG

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ACADEMIC EDUCATION

Fred Hutchinson Cancer Research Center

Sep 2019 – Jul 2022

PostDoc, Vaccine and Infectious Disease Division

(<https://www.fredhutch.org/en/research/divisions/vaccine-infectious-disease-division.html>)

Project: Single-Cell Cytokine Clustering Analysis in Vaccine Studies

Supervisor: Prof. Ollivier Hyrien

Temple University, Fox School of Business

Aug 2015 – Aug 2019

Ph.D., Department of Statistical Science

(<https://www.fox.temple.edu/departments/statistical-science/>)

Thesis Topic: Graph-based Modern Nonparametrics For High-dimensional Data

Advisor: Prof. Subhadeep (DEEP) Mukhopadhyay

University of Southern California

Sep 2012 – June 2014

M.S., Mathematical Finance

(<https://dornsife.usc.edu/mathematical-finance/>)

Research Topic: Trading Strategy based on Modified RSI signal

Central University of Finance and Economics

Sep 2008 – June 2012

B.S., Applied Mathematics (Currently School of Statistics)

(<http://en.stat.cufe.edu.cn/about/index.html>)

Thesis Topic: Clustering Based Cash-flow Anomaly Detection

RESEARCH INTERESTS

Biomedical Data Science, Applied Nonparametric Statistics, Graph Data Science, Large-scale Inference.

HONORS & AWARDS

- Winner of school-wide PhD research paper competition 2017
Temple University, Fox School of Business
- George Carides Memorial Award 2017
Temple University, Fox School of Business
- Meritorious award, Interdisciplinary Contest in Modeling 2011
Central University of Finance and Economics

PUBLICATIONS

Journal Publications:

1. Mukhopadhyay, S. and **Kaijun Wang** (2020) “A Nonparametric Approach to High-dimensional Ksample Comparison Problem”. *Biometrika*, **107(3)**, page 555–572

Abstract: High-dimensional k-sample comparison is a common applied problem. We construct a class of easy-to-implement distribution-free tests based on new nonparametric tools and unexplored connections with spectral graph theory. The test is shown to possess various desirable properties along with a characteristic exploratory flavor that has practical consequences. The numerical examples show that our method works surprisingly well under a broad range of realistic situations.

2. Mukhopadhyay, S. and **Kaijun Wang** (2021) “Spectral Graph Analysis: A Unified Explanation and Modern Perspectives” [arXiv:1901.07090](https://arxiv.org/abs/1901.07090) (*Accepted, Nature Scientific Reports*)

Abstract: Spectral graph analysis is undoubtedly the most favored technique for graph data analysis, both in theory and practice. The achievement of this paper is to take a step towards discovering a simple, yet universal statistical logic of spectral graph analysis, which has dual significance: (i) Theoretical side: The prescribed viewpoint accomplishes the miracle of unifying and generalizing the existing paradigm as a consequence of just a single formalism and algorithm. (ii) Practical side: it opens up several possibilities for constructing specially-designed more efficient spectral learning algorithms for complex networks; an example is given where we achieve more than a 350x speedup over conventional methods.

3. Zhu, Jiaqi, **Kaijun Wang**, Yunkun Wu, Zhongyi Hu, and Hongan Wang. (2016) “Mining User-Aware Rare Sequential Topic Patterns in Document Streams.” *IEEE Transactions on Knowledge and Data Engineering*, **28**, page 1790–1804.

Abstract: We proposed Sequential Topic Patterns (STPs) and formulated the problem of mining User-aware Rare Sequential Topic Patterns (URSTPs) in document streams on the Internet for characterizing and detecting personalized and abnormal behaviors of Internet users. The method can be applied in many real-life scenarios, such as real-time monitoring on abnormal user behaviors. The algorithms to solve problem involves three phases: preprocessing text data and identify sessions for different users, pattern-growth, and selecting URSTPs. Experiments on both real (Twitter) and simulated datasets show that our approach can indeed discover special users and interpretable URSTPs effectively and efficiently.

Under Review

4. Mukhopadhyay, S. and **Kaijun Wang** (2021) “On The Problem of Relevance in Statistical Inference”. [arXiv:2004.09588](https://arxiv.org/abs/2004.09588).

Abstract: Given a large cohort of “similar” cases one can construct an efficient statistical inference procedure by learning from the experience of others (also known as “borrowing strength” from the ensemble). But what if, instead, we were given a massive database of *heterogeneous* cases? It’s not obvious how to go about gathering strength when each piece of information is fuzzy. This paper develops a *new model* of large-scale inference to tackle some of the unsettled issues that surround the relevance problem. The central role is played by the concept of LASER, which are specially-designed Artificial RELevant Samples, and a vital piece to enable individualized custom-

tailored inference. Through examples, we demonstrate how this new statistical perspective answers previously unanswerable questions in a realistic and feasible way.

5. Mukhopadhyay, S. and **Kaijun Wang** (2021) “Statistical Machine Learning: An Integrated Approach” [arXiv:2005.13596](https://arxiv.org/abs/2005.13596).

Abstract: This paper introduces a new data analysis framework, called Integrated Statistical Learning (ISL) theory, which for the *first time*, offers solutions to blend the parametric statistical modeling and algorithmic machine learning into a coherent whole by establishing a link between them. The challenges and potential gains of this new *integrated* statistical thinking are illustrated through various examples.

Working Papers

6. **Kaijun Wang** and Ollivier Hyrien (2021) “Nonparametric Clustering for Single-Cell Subsets in Vaccine Studies”.

Description: Flow cytometry data are usually used in modern study of immune-related diseases. So far, various model have been proposed on how to process the signal intensity to identify cell subsets of different marker combinations, yet little has been said what to do with the resulting subsets. This is not a trivial matter as the resulting data set consists of sparse count data of high dimensionality, and analyzing it using traditional means are challenging. We believe that an important step to understanding this data set is finding a way to cluster the protein combination subsets based on their responses to the stimuli. I’m developing a nonparametric method to solve this problem by combining graph-based data science and machine learning algorithms.

SOFTWARE

1. **Kaijun Wang**, Mukhopadhyay, S. (2017). LPKsample: LP Nonparametric High Dimension K-Sample Comparison. URL: <https://cran.r-project.org/package=LPKsample>.
2. **Kaijun Wang**, Mukhopadhyay, S. (2018). LPGraph: Nonparametric Smoothing of Laplacian Graph Spectra. URL: <https://cran.r-project.org/package=LPGraph>.
3. **Kaijun Wang**, Mukhopadhyay, S. (2021). LPMachineLearning: Integrated Nonparametric Statistical Machine Learning. URL: <https://github.com/LPStat-Hub/LPMachineLearning>.

TEACHING EXPERIENCE

STAT 1001, Quantitative Methods for Business I	Fall 2017 and Spring 2018, 2019
STAT 1102, Quantitative Methods for Business II	Fall 2016

RESEARCH PROJECTS

IQVIA (Quintiles and IMS Health, Inc.): Internship July 2018 – August 2018
Nonparametric Modeling for Advanced Targeting of Medical Service
Industry Supervisor: Prof. Yong Cai;
Academic Supervisor: Prof. Subhadeep Mukhopadhyay

We worked with a large high-dimensional page-view data to build a model that can differentiate between patients and normal subjects based on the pattern in their browsing history. Structural Topics Model and Latent Dirichlet Allocation are used to study the raw web browser logs, and high dimensional multiple comparisons are performed to learn the difference. The computation was performed in R and Python.

Temple University: Deep Learning Project

Aug 2017 – Dec 2017

Deep Neural Network Model for Seizure EEG data

Instructor: Prof. Joseph Picone

In this project, I built a deep learning model for identifying seizure from EEG data. For each EEG record the features vectors were obtained using cepstral transformation technique. I studied the effect of different setups of layers, optimizers, batch size and loss function on the model training and prediction. The deep learning models are implemented and trained using Keras package under Python.

(https://www.isip.piconepress.com/wang_kaijun.pdf)

Institute of Software, Chinese Academy of Science

June 2015 – Dec 2015

Mining User-Aware Rare Sequential Topic Patterns in Document Streams

Joint work with J. Zhu, Y. Wu, Z. Hu and H. Wang

We proposed a method for mining user specific rare sequential topic pattern. The method includes steps that pre-process the input into user specific sessions, grow sequential patterns and their support, as well as mining the user-aware sequential topic pattern. I worked with Dr. Zhu and his group for developing the framework and running it on different data sets for demonstration. Our papers are published at *IEEE Transactions on Knowledge and Data Engineering*. (<http://ieeexplore.ieee.org/document/7431989/>)

Institute of Software, Chinese Academy of Science

Aug 2014 – Jan 2015

Pecuniary Loss Computation for MH370 Victims

Leader: Xiaoming Deng

Our team developed a software that can compute the pecuniary compensation for MH370 victims. This is a joint project between Institute of Software and Chinese Ministry of Justice. This software is utilized for the negotiation of compensations.

PRESENTATIONS

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| 1. Graph-Based Compressive High-Dimensional Testing, JSM Conference | 2020 |
| 2. Graph-based Modern Nonparametrics For High-Dimensional Data | 2018 |
| 3. Nonparametric High dimensional K-sample Comparison | 2018 |
| 4. Analysis of Small Social Networks: Karate Club and Sampson Monk Network Data | 2017 |
| 5. Time Series Analysis on Asian Stock Indices | 2017 |
| 6. Nonparametric generalized linear model and Comparison with COM-Poisson | 2016 |
| 7. Nonparametric Analyses of Brain Connectivity Data | 2016 |