

Zishuo ZHAO

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IIIS, Tsinghua University

1 Education Background

- **2012/09 - 2015/06** No.1 Middle School Affiliated to Central China Normal University
National Second Prize in CMO'14
Provincial First Prize in NOIP'13
- **2015/08 - 2016/05** Undergraduate, Department of Computer Science and Technology, Tsinghua University
15th place in 20th Artificial Intelligence Programming Contest of Tsinghua University. [AI Code]
- **2016/05 - 2020/06** Undergraduate, Yao Class, Institute for Interdisciplinary Information Sciences, Tsinghua University
- Overall GPA: 3.64/4
GPA in recent 2 years: 3.69/4
Major GPA: 3.76/4
- Honors:
Yao Class Student Fellowship, 2016~2020.
Award for Arts Excellence, 2018.

- Grades of Selected Courses:

| | |
|--|-------|
| Linear Algebra I/II | A-/A+ |
| Foundation of Object-Oriented Programming | A |
| Discrete Mathematics I/II | A/A- |
| Physics I/II (in English) | A/A- |
| Mathematics for Computer Science | A- |
| Theory and Practice of Modern Information Technology | A |
| Machine Learning | A- |
| Numerical Analysis | A- |
| Computer Organization and Architecture | A |
| Speech Science, Technology and Innovative Applications | A- |
| Computational Modeling for Urban System Regulation | A |
| Topology | A- |
| Research Practice | A |
| Diploma Project (Thesis) | A |

2 Language

- Mandarin Chinese: native language.

- English: scored V156,Q170,AW3.5 in GRE General Test (taken on September 23, 2017), 102(R26, L27, S22, W27) in TOEFL iBT (taken on June 1, 2019).
- Programming Language: mainly using C++ and MATLAB, also with some command of Java, Python and PHP.

3 Personal Statement

I am a senior student in IIIS Tsinghua. During high-school and college years I am interested in mathematics and computer science, and in college years, I have always been interested in fields with deep association with mathematics.

In early days in Department of CST, I reinforced my basic skills and knowledge in computer, and after joining IIIS, I have been working my best to take challenge and improve my abilities for academic career in the future. At the risk of GPA, I always choose to take courses in which I can learn most. During the seemingly overwhelming but fulfilling semester, beside managing to learn well all those courses I love, I realized and escalated my full potential to learn and schedule my life in pervasive challenges.

Because of the variety of courses I have taken, and after the visiting program in UT Austin, I am now interested in a wide range of scopes, including geometry/topology/graphics, statistics/information theory, as well as optimization/machine learning theory. During the graduation project in Tsinghua CG Lab, advised by Shi-Min Hu, I developed particular interest in the area of computer vision in the geometric perspective, and now I look forward to do further interdisciplinary research in the fields that combine mathematical/physical models and data processing.

4 Publications

ClusterSLAM: A SLAM Backend for Simultaneous Rigid Body Clustering and Motion Estimation

Jiahui Huang, Sheng Yang, Zishuo Zhao, Yukun Lai, Shi-Min Hu.

Accepted for ICCV 2019. [Link]

5 Selected Projects

5.1 Research Experiences

quq: A Quick Batched Algorithm for Long Read Mapping, 2020/03 - now

- Advised by Yuan Zhou
- Developed an algorithm to efficiently match multiple long noisy gene patterns with a genome
- Used a hash-pool structure for pattern strings to recognize multiple patterns in one-pass
- Improved both accuracy and speed of state-of-the-art algorithms

LiDAR-Based Map Construction and Localization, for visiting program in UC Berkeley, 2019/08 - 2020/01.

- Advised by Masayoshi Tomizuka
- Combined state-of-the-art SLAM and localization techniques with GPS data for robust localization
- Autonomous relocalization when tracking failure is detected

- Developed an “atlas” data structure with topological connections for precision and efficiency in real-time localization

Scene Analysis and Reconstruction Based on Geometric Distances, for Bachelor Thesis, 2019/03 - 2019/06.

- Advised by Shi-Min Hu
- Proposed a novel specification of geometrical stability on bar-joint frameworks for stable reconstruction against noises
- Proposed an algorithm to construct low-cost graph of distance constraints that stably determine a spatial structure
- Graded A(≥ 95 points)
- [arXiv:1907.06441]

ClusterSLAM: A SLAM Backend for Simultaneous Rigid Body Clustering and Motion Estimation, 2018/09 - 2019/03.

- Advised by Shi-Min Hu
- Utilization of SLAM method in reconstructing dynamic scenes and tracking moving objects
- My contribution: developed the *motion consistency matrix* and utilized *complete-linkage clustering* algorithm for clustering landmarks into motion groups
- Accepted for ICCV 2019.

Data-Driven Shape Reconstruction Using Coupled Geometric and Topological Basis, for visiting program in UT Austin, 2018/04 - 2018/11.

- Advised by Qixing Huang, Chandrajit Bajaj
- Using dictionary learning method to utilize prior knowledge in shape reconstruction
- With topological features for better structure reconstruction

Musical Instrument Classification via Low-Dimensional Feature Vectors, *research project* for Speech Science and Technology course, 2017/03 - 2017/06.

- Advised by Tan Lee, joint work with Haoyun Wang.
- 90% accuracy to classify 6 representative instruments with models of spectral features and least machine learning tools (only simple 32-dimensional SVM).
- Innovative work based on observations and explorations.
- [Source Code][arXiv:1909.08444]

Admission Score Prediction and Advice System, for Summer Internship in Sogou Inc, 2016/07.

- Utilized mathematical models to convert Raw Scores into “Ability Levels” and calculated Ability Levels necessary for admission from data.
- Effectively negated fluctuations of difficulties and discriminative powers in different years and provinces.
- Typical error around 3-5 points (in 750), practical for advising high school graduates.
- [Source Code]

5.2 Course Projects

Extensive Exploration on Generalized Birthday Paradox, for Cryptography course, 2018/01.

- Derived rigorous bounds for Hash collision;
- For non-uniform distributions and multiple (instead of two) appearances.

Sharing Power Storage for Undeveloped Countries, for Computational Modeling for Urban System Regulation course, 2017/09.

- Designed power storage plans for stable power supply on unstable grids.
- Used sampling method to estimate the optimal capacity, balancing sampling cost and error penalty.
- Designed two charging policies to endorse social fairness.
- [Link]

An Asymptotic Analysis on Generalized Secretary Problem, for Game Theory course, 2017/06.

- Proved that with most payoff functions of relative ranking, the optimal cutoff point is $O(\sqrt{n})$.
- Given an asymptotic upper bound for the constant w.r.t. satisfying functions.
- Generalized the \sqrt{n} result with linear cardinal payoff function.
- Challenged the well-known “37% rule” in practical optimal stopping strategies.

Lung Nodule Detection Based on ConvNet, for Machine Learning course, 2017/01.

- Joint work with Jiafan He, Yunchao Liu, Changzhi Xie and Haochen Zhang.
- Practiced multiple tools of SVM, AdaBoost and CNN on real-world datasets for understanding of ML.

Heuristic Algorithm for 1-2 TSP Problem, for summer course Theory and Practice of Modern Information Technology, 2016/08.

- Joint work with Ziyao Lin, IIIS Tsinghua.
- Initialization via heuristics of approximate optimal 2-matching.
- Optimization via Simulated Annealing.

Software Plagiarism Detection, for Object-Oriented Programming course, 2016/06.

- Extracted fingerprints from codes and compare with KM algorithm.
- Delicately designed algorithm to optimize both fingerprint size and computational complexity.
- Robust against several cheating tricks e.g. block swapping.
- [Link]

(Updated on Sept 4, 2020)