

# 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
- 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 intended to do research in especially 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. In future years, I look forward to utilizing extensive knowledge to do interdisciplinary research with a solid mathematical background, especially in fields combining graphics and data science/machine learning.

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 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

**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( $\geq 95$  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]

**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.

## 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.

**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.

*(Updated on Sept 16, 2019)*