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 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

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($\geq$ 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][arXiv:1909.08444]

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

- Utilized mathmatical 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 Nov 20, 2019)