

# KERRY HE

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## EDUCATION

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**Doctor of Philosophy** – *Electrical and Computer Systems Engineering* 2022 – Present  
Monash University, Clayton, Australia

- **Thesis title:** Convex optimisation methods for quantum information theory
- **Advisors:** James Saunderson and Hamza Fawzi
- **Expected completion date:** Dec 2025

**Bachelor of Engineering (Honours)/Commerce** – *Mechatronics Engineering/Finance* 2017 – 2022  
Monash University, Clayton, Australia

- **WAM:** 93.348/100, **GPA:** 3.975/4
- Best performing student in the cohort for both degrees.

## RESEARCH EXPERIENCE

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**Doctor of Philosophy** – *Convex Optimisation Methods for Quantum Information Theory* 2022 – Present

- Proved convergence rates and convexity properties for gradient-based and interior-point methods for optimization problems involving functions of matrices, such as quantum relative entropies, matrix geometric means, and Rényi relative entropies.
- Applied these methods to compute quantum key rates for quantum cryptographic protocols, quantum channel capacities, etc., which previously could not be computed using existing convex optimization techniques.
- Developed an open-source conic programming solver in Python which exploits common problem structures which arise in practice to solve problems arising in quantum information theory up to 3000 times faster compared to state-of-the-art software.

**Summer Research Scholarships** – *Monash Robotics* 2020 – 2022

- Developed an optimal control algorithm for robots with arms to avoid obstructing their own vision, allowing for improved closed-loop control and success in grasping tasks (2022).
- Designed and implemented a convolutional neural network with PyTorch to identify the upright orientation of common household objects (2020).

**Engineering Honours Project** – *Monash Motorsport* 2021

- Designed a model predictive controller for an autonomous Formula-style racecar, implemented the controller in C++, and evaluated the controller's performance in a simulated environment.
- Controller achieved up to 50% faster lap times in simulated experiments compared to the previous controller used by the Monash Motorsport team.

## SKILLS

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**Coding:** Python, MATLAB, Julia, C++, Git, PyTorch, Linux.

**Technical:** Convex optimization, linear algebra, matrix analysis, numerical methods, quantum information theory, robotics, machine learning.

## TEACHING/EXTRACURRICULAR EXPERIENCE

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### Deputy Unit Coordinator – ECE4132 Control System Design

Present

- Supported Chief Examiner with administrative tasks, assisting with student enquiries, and acting as the lead Teaching Assistant within the unit.

### Summer Research Project Supervisor

2023

- Supervised two undergraduate students researching optimal control techniques for a robotic arm to grasp objects in complex, cluttered environments.
- Responsibilities included conceptualizing the project brief, chairing weekly meetings with the students, and providing expert advice and feedback throughout the project.

### Teaching Assistant

2019 – Present

- ECE4132 Control System Design (2023 – Present).
- ECE3093 Optimisation and Numerical Methods for Engineers (2024 – Present).
- TRC2201 Mechanics and TRC3200 Dynamical Systems (2019 – 2023).

### Monash Motorsport

2018 – 2021

- Autonomous Systems department member involved in developing perception, localisation, and planning algorithms for Australia's first autonomous Formula Student racecar.
- Held multiple leadership roles, including:
  - Head of Autonomous Systems (2020): Leading and mentoring the department, making high level technical decisions, facilitating communications with other departments.
  - Autonomous Systems Principal Engineer (2021): Involved with giving technical advice to department members and management.

## PUBLICATIONS

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### Preprints

K. He, J. Saunderson, H Fawzi, "QICS: Quantum Information Conic Solver," *arXiv preprint arXiv:2410.17803*, 2024.

K. He, J. Saunderson, H Fawzi, "Exploiting Structure in Quantum Relative Entropy Programs," *arXiv preprint arXiv:2407.00241*, 2024.

### Journal publications

K. He, J. Saunderson, H Fawzi, "A Bregman Proximal Perspective on Classical and Quantum Blahut-Arimoto Algorithms," *IEEE Transactions on Information Theory*, vol. 70, no. 8, pp. 5710-5730, August 2024.

R. Newbury, J. Collins, K. He, J. Pan, I. Posner, D. Howard, A. Cosgun, "A Review of Differentiable Simulators," *IEEE Access*, vol. 12, pp. 97581-97604, July 2024.

K. He, J. Saunderson, H Fawzi, "Efficient Computation of the Quantum Rate-Distortion Function," *Quantum*, vol. 8, pp. 1314, April 2024.

K. He, R. Newbury, T. Tran, J. Haviland, B. Burgess-Limerick, D. Kulić, P. Corke, and A. Cosgun, "Visibility Maximization Controller for Robotic Manipulation," in *IEEE Robotics and Automation Letters*, vol. 7, no. 3, pp. 8479-8486, July 2022

R. Newbury, K. He, A. Cosgun and T. Drummond, "Learning to Place Objects Onto Flat Surfaces in Upright Orientations," *IEEE Robotics and Automation Letters*, vol. 6, no. 3, pp. 4377-4384, July 2021.

## Conference proceedings

J. Pan, K. He, J. M. Ong, and A. Cosgun, "Variable Grasp Pose and Commitment for Trajectory Optimization," in *2023 5th International Congress on Human-Computer Interaction, Optimization and Robotic Applications*, Istanbul, Turkiye, 2023, pp. 1-6.

L. Tian, K. He, S. Xu, A. Cosgun, and D. Kulić, "Crafting with a Robot Assistant: Use Social Cues to Inform Adaptive Handovers in Human-Robot Collaboration," in *Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction*, Stockholm, Sweden, 2023, pp. 252-260.

K. He, P. Simini, W. P. Chan, D. Kulić, E. Croft and A. Cosgun, "On-The-Go Robot-to-Human Handovers with a Mobile Manipulator," in *2022 31st IEEE International Conference on Robot and Human Interactive Communication*, Napoli, Italy, 2022, pp. 729-734.

K. He, B. Johns, E. Abdi, and M. Arashpour, "Camera View from Crane Payload: Video Stabilization," in *Proceedings of the 2021 Australasian Conference on Robotics and Automation*, Melbourne, Australia, 2021, pp. 1-9.

## TALKS AND PRESENTATIONS

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### **The 25th International Symposium on Mathematical Programming (ISMP 2024)**

*Title: Bregman Proximal Methods for Quantum Information Theoretic Problems*

July 2024, Montreal, Canada

### **The 67th Annual Meeting of the Australian Mathematical Society (AustMS 2023)**

*Title: Computation of the Quantum Rate-Distortion Function*

December 2023, Brisbane, Australia

### **SIAM Conference on Optimization (OP23)**

*Title: Mirror Descent and Quantum Blahut-Arimoto Algorithms*

June 2023, Seattle, United States

### **The 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2022)**

*Title: Visibility Maximization Controller for Robotic Manipulation*

October 2022, Kyoto, Japan (Online)

### **The 31st IEEE International Conference on Robot and Human Interactive Communication (RO-MAN 2022)**

*Title: On-The-Go Robot-to-Human Handovers with a Mobile Manipulator*

August 2022, Napoli, Italy (Online)

### **Australasian Conference on Robotics and Automation (ACRA 2021)**

*Title: Camera View From Crane Payload: Video Stabilization*

December 2021, Melbourne, Australia (Online)

### **The 2021 International Conference on Robotics and Automation (ICRA 2021)**

*Title: Learning to Place Objects onto Flat Surfaces in Upright Orientations*

June 2021, Xi'an, China (Online)

## AWARDS AND HONOURS

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Monash Graduate Excellence Scholarship (2022 – 2025)

University Medal for Undergraduate Academic Excellence in the Faculty of Engineering (2022)

Dean's Student Excellence Award for the top Undergraduate in Commerce (2022)