CONTACT INFORMATION

Website: `arjunashokrao.me`   Email: `arjunrao@link.cuhk.edu.hk`

RESEARCH INTERESTS

I am most interested in advancing theoretical results in fundamental deep learning, and developing training algorithms that can be reliably utilized for novel science applications. My research agenda spans several related sub-fields such as:

- Optimization for better generalization in deep learning: Including developing optimizers that are 1. stable, 2. robust 3. converge in a decentralized setting
- Adversarial Robustness
- Machine Learning for Earth Science Applications

EDUCATION

The Chinese University of Hong Kong (CUHK)
Bachelor of Engineering in Financial Technology (Systems Engineering)
Minor in Computer Science
Dean's List 2018-2021
Selected Coursework: Machine Learning, Stochastic Models, Statistical Learning Theory, Optimization Theory, Numerical Analysis, Functional Analysis, Data Structures, Human-Computer Interaction

RESEARCH EXPERIENCE

NASA Jet Propulsion Laboratory, Caltech, Pasadena, CA   **06/2021—09/2021**
Machine Learning and Instrument Autonomy Group

- Worked in collaboration with the Imaging Spectroscopy at the Jet Propulsion Laboratory to improve robustness of deep learning models trained to detect methane emissions from hyperspectral imagery captured through NASA's airborne and spaceborne imaging spectrometers.
- Proposed training algorithms with synthetic geospatial data generated through 'Large Eddy Simulations': a mathematical model built to simulate the distribution and structure of methane emissions.
- **Advisors: Dr. Andrew Thorpe**, **Dr. Steffen Mauceri**, **Dr. Brian Bue**.
- **Fellowship:** Caltech SURF Award.

The Chinese University of Hong Kong, Hong Kong   **09/2020—Present**
Network Science and Optimization Laboratory

- Worked on large scale decentralized deep learning algorithms - where data is split between N workers who can only communicate with their immediate neighbors.
- Empirically demonstrated that solutions found by compressed decentralized stochastic gradient algorithms are invariant to model size. Proposed an *inexact-consensus* decentralized learning algorithm.
- Advisor: **Professor Hoi-To Wai**

The Chinese University of Hong Kong, Hong Kong   **05/2020—09/2020**
Deep Vision Laboratory

- Exposed vulnerabilities in autonomous driving cars' vision systems to 'adversarial examples': carefully crafted images aimed to misguide depth-detection algorithms.
- Developed *SmoothStereo*: An adversarial training algorithm that exploits implicit spatial relationships in a stereo-vision system.
- Advisor: **Professor Bei Yu**

PUBLICATIONS	[1] **"Counteracting Adversarial Attacks in Autonomous Driving"**
	Qi Sun, **Arjun Ashok Rao**, Xufeng Yao, Bei Yu, Shiyan Hu.
	IEEE/ACM International Conference on Computer-Aided Design (**ICCAD**), Westminster, CO, Nov. 2-5, 2020. (Invited Paper)

	[2] **"An Empirical Analysis on Compressed Decentralized Stochastic Gradient Algorithms with Overparameterized Models"**
	Arjun Ashok Rao, Hoi-To Wai.
	Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (**APSIPA**), 2021

| | [3] **"Improving Imaging Spectrometer Methane Plume Detection with Large Eddy Simulations"** |
| | **Arjun Ashok Rao**, Steffen Mauceri, Andrew K. Thorpe, Jake H. Lee, Brian D. Bue, Siraput Jongaramrunggruang, and Riley M. Duren, *American Geophysical Union, Fall Meeting 2021* |

| | [4] **"Methane Plume Detection with Future Orbital Imaging Spectrometers"** |
| | Jake Lee, Steffen Mauceri, Sharmita Dey, **Arjun Ashok Rao**, Ryan Alimo, Andrew Thorpe, Siraput Jongaramrungruang, *American Geophysical Union, Fall Meeting 2021* |

PRESENTATIONS

SGD: A Stability Perspective, Network Science and Optimization Laboratory Group Meeting. (December 2021) [SLIDES]

Improving Imaging Spectrometer Methane Plume Detection with Large Eddy Simulations, Summer Undergraduate Research Fellowship at JPL Final Presentation. (September 2021) [SLIDES]

Decentralized Deep Learning with Inexact Consensus, Senior Thesis Presentation, CUHK. (December 2021) [SLIDES]

WORK EXPERIENCE

Asiabots, Hong Kong   04/2020—06/2020
Machine Learning Intern, Asiabots Voice AI

Developed a semi-supervised Ladder-VAE based TTS Model For emotion and speech generation. Improved model understanding by developing algorithms to sample latent space of VAEs and generate speech prosody changes with alteration in high-dimensional latent variables.

LSCM R&D Centre, Hong Kong   06/2019—08/2019
Summer Intern, Financial Technology R&D Department

Built an attention-transformer model for Chinese to English legal document translation. Our machine translation model demonstrated significant BLEU score improvements and captured essential context in legal documents.

HONORS AND AWARDS

Caltech Summer Undergraduate Research Fellowship (SURF)	**2021**
CUHK Admission Scholarship	**2018 − Present**
Faculty of Engineering Admission Scholarship, CUHK	**2018 − Present**
CUHK Outstanding Student Award	**2020**
Cyberport Creative Micro-Fund Scholarship	**2020**
Microsoft Learn Student Ambassador	**2019**

OUTREACH

ICCV Student Volunteer Award	**2021**
Flux Payments: A RL-powered financial planner to help ease bill payment during COVID-19 (100,000 HKD funding through CCMF Program, Hong Kong)	**2020 − Present**
International Student Association at CUHK	**2019 − 2020**
Volunteer Educator, Sri Ramana Maharishi School for the Blind - Spent two years as a volunteer part-time computer science instructor for visually disabled students in Bangalore, India. Helped teach concepts in data structures, algorithms, and basic computing.	**2017 − 2019**