

# IGOR SADALSKI

EU Citizen (Poland) — UK Pre-Settled Status

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## Education

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### Imperial College London

London, UK

*MSc Computer Science (AI and ML)*

*Sep. 2023 – Sep. 2024*

- **Selected Coursework:** Deep Learning, Reinforcement Learning, Computer Vision, Robot Learning, Mathematics for Machine Learning, Graph-Based Learning, Software Engineering for Machine Learning Systems, Natural Language Processing, Introduction to Machine Learning

### Imperial College London

London, UK

*BEng Mechanical Engineering (Mechatronics), **First Class Honours***

*Oct. 2020 – Jun. 2023*

- **Selected Coursework:** Mathematics and Computing I and II, Mathematics III, Statistics (both at Mathematics Dep.), Machine Learning: Theory and Applications (at Computing Dep.), Embedded C for micro-controllers.
- **Literature Review:** "*Application of Reinforcement Learning for Autonomous Driving.*", written as a review of the state-of-the-art techniques : algorithms (DQN, DDPG, PPO), meta and transfer learning, safety.

## Experience

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### Harvard University

Boston, USA

*Graduate Researcher (Master Thesis)*

*Mar. 2024 – Sep. 2024*

- Accepted for a 6 month long on-site placement in Harvard Computer Science Department to write master thesis.
- Working with Prof. Stephanie Gil on Demand responsive public transportation for future planning in urban setting. Joint with the supervision from Imperial College with Prof. Francesco Belardinelli. Based on Harvard dataset of internal bus routes the goal of the project is to come up with a framework to predict demand. This will be achieved using Transformers that attend to multi-modal data points that could associate with increased demand in specific areas and then planning optimal paths and deploying the different fleet vehicles efficiently during peak demand time.

### California Institute of Technology (Caltech)

Pasadena, USA

*Undergraduate Researcher*

*Jun. 2023 – Aug. 2023.*

- Project Title: "**Generative Modeling for Safe Control Using Conditional Variational Autoencoders**", full scholarship in Advanced Mechanical Bipedal Experimental Robotics Lab (part of Computing + Mathematical Sciences Dept.) under Prof. Aaron Ames.
- Based on the literature implemented in PyTorch a conditional variational autoencoder (CVAE) compatible with the data obtained from the hardware platform.
- Use CVAE to compute mean and covariance of generated data and then used Gaussian mixture model to approximate the underlying data distribution and develop Control Barrier Function controller.
- starting from an academic literature I implemented in Python an end-to-end software system which automatically: took historical data from a drone after a flight, trained CVAE developed in PyTorch on it, automatically tuned hyperparameters by using Weights and Biases software and lastly optimized network for specific embedded processor running on a drone.

### California Institute of Technology (Caltech)

Pasadena, USA

*Undergraduate Researcher*

*Jun. 2022 – Aug. 2022*

- Project Title: "**Nonlinear Model Predictive Control for a 3D hopper**", full scholarship under Prof. Aaron Ames, part of the SURF program; I helped speed-up the inference time of control algorithm and decrease communication latency running on a 3D hopping custom develop robot. Notably, I rewrote available code using Eigen, optimized C++ library used for efficient matrix operations, speeding up the calculations significantly.
- Developed supporting libraries and functions (e.g. Continuous linearisation of dynamics) for an MPC using C++ Eigen and Pinocchio libraries, created CMake files to compile the project and worked with Git and GitHub.
- Setup simulation environment and controller block in MuJoCo, recreated the robot in MJCF and URDF formats.
- Developed a WiFi PC-robot communication running at 200Hz and optimised it to operate at a 500Hz with minimal packet loss, later filtered noisy data with filters and by integrating OptiTrack using ROS I.

## Academic Publications

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- **"Generative Modelling of Residuals for Real-Time Risk-Sensitive Safety with Discrete-Time Control Barrier Functions"**, *Ryan K. Cosner, Igor Sadalski, Jana K. Woo, Preston Culbertson, Aaron D. Ames*, 2023, submitted for ICRA 2024
- **"Nonlinear Model Predictive Control of a 3D Hopping Robot: Leveraging Lie Group Integrators for Dynamically Stable Behaviors"**, *Noel Csomay-Shanklin, Victor D. Dorobantu, and Aaron D. Ames* (I was mentioned in acknowledgements for help with experimental hardware), ICRA 2022.

## Programming Projects

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### RAG Based Chatbot Allowing You to Talk to Your Book

*Spring 2024*

- Experimented with various preprocessing document techniques, performed indexing using Elastic Search, a type of a vector database, used newest version of Elastic Learned Sparse Encode to get embeddings for pre-processed parts.
- Used Hugging face to download the weights for the google gemma-2b-it tokenizer and model; created a prompt building algorithm that combined the retrieved book passages with the user query and returned the results in a interactive session with user.

### Acute Kidney Injury Prediction System for a Simulated Hospital

*Spring 2024*

- Led the development of an acute kidney injury (AKI) prediction system for a simulated hospital, exceeding the NHS algorithm benchmark by enhancing detection rates from 70% to 95%. Helped design software architecture to obtain high throughput and low latency predictions.
- Designed and implemented an end-to-end system utilizing Docker and Kubernetes for cloud deployment. Engineered infrastructure resilience for common data-center failures, addressing issues like unexpected socket closures and data retrieval on cluster node failures, leveraging open-source solutions to monitor the system.
- Implemented Prometheus for event monitoring and alerting; developed comprehensive unit and integration tests compatible with the python unittest framework; utilized the HTTP protocol to seamlessly transmit information to doctor interfaces upon illness detection; created algorithm to parse messages received via MLLP communication layer in HL7 format, actual format used by most of UK hospitals.

### Optimal PCB routing with RL

*Winter 2023/2024*

- Finding optimal placement of components on a PCB board so that after the routing we have minimal total connection distance. This is an NP-Hard problem and RL acts only as an approximation of a solution.
- Implemented DQN in PyTorch and trained it on a custom simulation environment of simplified PCB boards, used A\* to estimate optimal cable lengths for a given generated RL configurations.

## Extracurriculars

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### Imperial Formula Student Artificial Intelligence

**London, UK**

*Head of Path Planning and Control*

*Jun. 2021 – May 2022*

- Founded Imperial Driverless, first ever team of Imperial College students that develop software for a fully autonomous racing car contesting in the famous Formula Student Artificial Intelligence UK competition

### Imperial Data Science Society

**London, UK**

*Vice Chair*

*Oct. 2021 – Nov. 2022*

- Selected vice chair of an organisation with over 1100 members, responsible for running committee meetings.
- Helped organize one of the largest student-organised data science hackathon in the UK (AIHACK) for £2000 worth of prizes.

### Creator Fund (VC)

**London, UK**

*Student Analyst*

*Oct. 2022 – Dec. 2022*

- Worked part-time as a roboticist analyst at Europe's leading VC supporting deep-tech academics university spinoffs, companies: Touchlab – electronic skin for robots, RecyclEye – computer vision for waste industry.
- Collaborated with a team of 40+ peers (7 percent acceptance rate) including mostly PhD and only few undergraduates.

## Technical Skills

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**Languages:** Python3, C/C++, SQL

**Developer Tools:** Git, GitLab/Github, Docker, Kubernetes, Linux, Ubuntu, Weights and Biases, Prometheus, unittest, LangChain, Elastic Search, Hugging Face

**Technologies/Frameworks:** PyTorch, TensorFlow, Eigen, numpy, pandas, scikit-learn, xgboost, matplotlib