Anas Makdesi

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Websites: anas-makdesi.github.io, GitHub, LinkedIn, Scholar.

Research Experience

Independent Research and Open-Source Software (**09/2026 – present**)

Munich, Germany | github.com/anas-makdesi

- Turned my PhD and postdoc methods into open, tested research software (see Research software below), and used them in new safety-filter and real-time MPC projects.

Postdoctoral Researcher (**02/2025 – 08/2026**)

Ludwig-Maximilians-Universität München (LMU) | Munich, Germany

Supervisor: Majid Zamani

Main Topics:

- Data-Driven Invariance: Developed frameworks to identify invariant sets directly from experimental data guaranteeing system safety without explicit analytical models.
- Monotone Embedding: Researched embedding techniques to transform non-monotone systems into higher-dimensional monotone systems, facilitating efficient reachability analysis and abstraction.
- Abstraction Refinement: Optimized the partitioning of the state space for data-driven abstractions (CCTA 2026).

Supervision and collaborations:

- Helped supervise a PhD student at LMU Munich (2025 – 2026), including a joint paper in preparation.
- Collaborated remotely with researchers at the University of Colorado Boulder, UM6P (Morocco) and Caltech.

Education

PhD thesis in Automatic Control (**09/2020 – 12/2023**)

University of Paris-Saclay (CentraleSupélec), Laboratory of Signals and Systems L2S | Gif-sur-Yvette, France

Supervisors: **Antoine Girard, Laurent Fribourg**

Main Topics:

- Data-driven abstraction of unknown nonlinear systems.
- Data-driven approaches for guaranteed safe control of systems.
- Robust learning-based Model Predictive Control.
- Safe navigation.

Activities:

- Research visit to **HyCoDev** lab at Newcastle University; a collaboration with Prof. Sadegh Soudjani's team on safe learning and exploration (**06/2023**).
- **Data and learning for control** summer school, International Summer School of Automatic Control GIPSA-lab, Grenoble (**09/2021**).
- **Learning-based predictive control** summer school, European Embedded Control Institution, ETH, Zurich (**07/2022**).
- **Learning to control** summer school, European Embedded Control Institution, Imperial College, London (**06/2023**).
- **Modelling, Estimation, and Control using Set-Based Methods** winter school, Centrale Lille, Lille (**02/2024**).

(2024: independent research and travel in Europe)

Master of Science in Automation, Signal, and Image Processing (**09/2019 – 08/2020**)
University of Paris-Saclay | Gif-sur-Yvette, France

- Variety of courses covering topics in image processing and control.
- Graduation project on the data-driven control of the class of monotone systems.

M1(one year of master study) in Control Systems (**10/2017 – 10/2018**)
Higher Institute for Applied Sciences and Technology | Damascus, Syria

- One year of classes dedicated to advanced control topics.

Diplôme d'Ingénieur in Electronic Systems (**08/2012 – 08/2017**)
Higher Institute for Applied Sciences and Technology | Damascus, Syria

- Graduation project on the control of three-degree-of-freedom helicopters.
- HIAST is a highly selective and prestigious academic institution in Syria, built to conform to the French system of 'Grandes Écoles'.
- Qualified twice for the International Robot Olympiad.

Publications and Presentations

Journal papers:

- Safe Learning-Based Model Predictive Control Using the Compatible Models Approach, *European Journal of Control*, A Makdesi, A Girard, L Fribourg 2023. Code: compatible-mpc.
- Data-Driven Models of Monotone Systems, *IEEE Transactions on Automatic Control*, A Makdesi, A Girard, L Fribourg 2024. Code: ddma.
- Complete Abstractions of Monotone Control Systems: From Model-Based to Data-Driven Systems, *IEEE Transactions on Automatic Control*, A Saoud, A Makdesi, M Maghenem, A Girard, M Arcak (submitted).

International conferences:

- Monotone Embedding for Hierarchical Control of Linear Systems with Disturbances, *IEEE Conference on Decision and Control (CDC)*, A Makdesi, M Zamani, S Jafarpour 2026 (accepted). A journal extension is in preparation.
- Data-Driven Controlled Invariance via Monotone Embeddings, *IFAC World Congress*, A Makdesi, M Zamani, S Jafarpour 2026. Code: ddma.
- Data-Driven Synthesis of Controlled Invariant Sets for Monotone Systems, *IFAC World Congress*, A Makdesi, M Zamani 2026. Code: ddma.
- Rectangular Partitioning Optimization for Data-Driven Abstractions of Monotone Systems, *IEEE Conference on Control Technology and Applications (CCTA)*, A Makdesi, M Zamani 2026.
- Online Learning for Safe Model Predictive Control with the Compatible Models Approach, *IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)*, A Makdesi, A Girard, L Fribourg 2024. Code: compatible-mpc.
- Data-Driven Abstraction of Monotone Systems, *Learning for Dynamics and Control (L4DC)*, A Makdesi, A Girard, L Fribourg 2021 (oral). Code: ddma.
- Efficient Data-Driven Abstraction of Monotone Systems with Disturbances, *IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)*, A Makdesi, A Girard, L Fribourg 2021. Code: ddma.

Presentations

- Monotone Systems: A Foundation for Efficient Interval Methods in Control, International Online Seminar on Interval Methods in Control Engineering, **2026.**
- Safe learning-based MPC using the compatible models approach, ECC, **2023.**

- An approach for safe learning-based MPC, SAGIP workshop on Hybrid Dynamical Systems & Cyber-Physical Systems, **2023.**
- A review of data-driven approaches in control theory, Paris-Saclay control seminar, **2022.**
- Data-driven abstraction of Monotone Systems, L4DC, **2021.**
- Data-driven models of monotone functions: Applications to safety-critical control, Institute DATAIA Paris-Saclay workshop on safe learning, **2021.**
- Efficient data-driven abstraction of monotone systems with disturbances, ADHS, **2021.**

Research Software

- **ddma — data-driven models and abstractions** (Python and MATLAB, multithreaded C++ core). Models with guaranteed error bounds learned from data, abstraction-based safe controller synthesis, data-driven controlled invariant sets and an online monitor of the model's assumptions. Implements the methods of the TAC 2024, L4DC 2021, ADHS 2021 and IFAC WC 2026 papers. Released on PyPI and as a MATLAB toolbox; 490+ tests, CI. github.com/anas-makdesi/ddma · docs: anas-makdesi.github.io/ddma
- **compatible-mpc** — safe learning-based MPC with the compatible models approach (EJC 2023, IFAC ADHS 2024), built on ddma. github.com/anas-makdesi/compatible-mpc
- **safety-filter** — safety filter certified from data around RL (SAC, PPO) and DeePC controllers, for lane keeping and a quadrotor: 0 crashes in 40 training runs vs 81–318 per run without the filter. The lane-keeping filter was also learned from real driving logs. github.com/anas-makdesi/safety-filter
- **Real-time nonlinear MPC** (acados) for a race car, a quadrotor and a 7-DOF robot arm, with C++ ROS 2 nodes, Docker and CI: 0.4–3.5 ms solve times, with data-driven certificates from ddma. vehicle-nmpc · quadrotor-nmpc · arm-nmpc

Working Experience

Research Intern (**05/2019 – 07/2019**)

CERN | Geneva, Switzerland

- Mobile robot: Position estimation.
- Battery charging circuits.

Team Lead, Research and Development (**04/2018 – 05/2019**)

Subh Engineering | Damascus, Syria

- Led a team of five engineers building mobile robots for civil engineering: defined the system architecture and requirements, planned the projects, hired two engineers, and did the scientific work on the hardest technical tasks.
- Surveying robot: reached sub-millimeter position accuracy by combining an older total station with a mounted commercial camera and printed markers. Built the robot's vision-based localization in Python (OpenCV): image processing, marker detection, triangulation and visual odometry.
- Sewer robot for in-pipe inspection: designed the embedded electronics and wrote the robot's software (Raspberry Pi, Python, C/C++). The robot was delivered and field-tested.

Research and Development Engineer (**10/2017 – 03/2018**)

Subh Engineering | Damascus, Syria

- Wrote the C/C++ control and sensing code for the robots and implemented and tuned closed-loop motor control on the real hardware.

- Developed the surveying robot and the sewer inspection robot as an engineer in the newly founded robotics section, before leading its team.

Teaching

Optimization tutorial classes (class of **2022** – class of **2023**)

CentraleSupélec | Gif-sur-Yvette, France

Taught groups of around 25 4th-year bachelor students problems in convex, linear, mixed integer optimization, Lagrange multipliers method, and metaheuristic optimization.

Linear control lab (class of **2022** – class of **2023**)

CentraleSupélec | Gif-sur-Yvette, France

Supervised groups of around 30 3rd-year bachelor students in lab sections about linear model identification, pole placement method, LQ, LQR, and robustness analysis.

Mobile robot lab (class of **2018**)

HIAST | Damascus, Syria

Supervised groups of around 20 5th-year bachelor students in lab sections to implement potential fields methods for path planning.

Services

- Representative of the PhD students of L2S.
- Reviewer for Automatica, LCSS, Transactions on Industrial Electronics, Nonlinear Analysis: Hybrid Systems, CDC, ECC.
- Co-organizer of the Paris-Saclay seminar on control (**2022 - 2023**).
- Founder and moderator of the physics club at HIAST (**2013 - 2017**).

HONORS

- First place in the Syrian Robot Olympiad (**2013**,**2015**).
- Participation in the International Physics Olympiad (**2011**).
- Second place in The Syrian Physics Olympiad (**2010**).

Technical Skills

Basic software

Microsoft Office - LaTeX - OpenCV.

Programming Languages

Python (NumPy, SciPy, PyTorch, CVXPY), C/C++ (pybind11, OpenMP), MATLAB/Simulink; ROS 2, Git, Linux, Docker, CI (GitHub Actions), pytest; acados, CasADi, Gurobi, MOSEK.

Engineering software

Autodesk Inventor - Arduino - Raspberry Pi.

Languages

Arabic: Mother tongue.

English: Excellent.

French: Good.

German: A1.

Recommendations & References

- Majid Zamani, Associate Professor at University of Colorado Boulder. Post-doc supervisor.
- Antoine Girard, PhD. Professor at L2S (CentraleSupélec). PhD supervisor.
- Laurent Fribourg, PhD. Professor at LMF (ENS Paris-Saclay). PhD co-supervisor.
- Saber Jafarpour, Research Assistant Professor at University of Colorado Boulder. We collaborated on topics related to (Monotone) Embedding.
- Adnane Saoud, Assistant Professor at University Mohammed VI Polytechnic. We collaborated on CPS-related topics.