

# Frederik Baymler Mathiesen

Delft Center for Systems and Control, Delft University of Technology, the Netherlands

Email: [frederik@baymler.com](mailto:frederik@baymler.com)

Research Interests: formal methods for dynamical systems • AI safety and verification • scientific machine learning

## Education

### **Delft University of Technology, Delft, the Netherlands (2021 - 2026)**

*PhD in Systems and Control*

- Dissertation: Safety Verification of Stochastic Systems with Applications to Autonomous Vehicles.
- Supervisors: Prof. Luca Laurenti, Delft Center for Systems and Control, TU Delft, and Prof. Simeon C. Calvert, Department of Transport & Planning, TU Delft.

*Awarded Dutch Institute for Systems and Control certificate.*

### **Aalborg University, Aalborg, Denmark (2016 - 2021)**

*MSc in Computer Science*

- Thesis: A Deep Learning Method for Numerically Solving Initial Value Problems of Hamiltonian Systems, jointly with Anders Madsen.
- Supervisors: Bin Yang and Jilin Hu, Department of Computer Science, Aalborg University.
- GPA: 11.9 out of 12<sup>1</sup> (top 1%)

*BSc in Computer Science*

- GPA: 11.7 out of 12 (top 1%)

### **Aalborg Tekniske Gymnasium, Aalborg, Denmark (2013 - 2016)**

- A-levels: Physics, Mathematics, English language, Electrical Engineering, and Danish language and literature.

## Professional Experience

### **Doctoral Researcher, Delft Center for Systems and Control, Delft University of Technology (2021 - present)**

- Topics: safety verification of stochastic systems, barrier functions, finite-state abstractions, neural network verification, automated vehicles.

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<sup>1</sup> Grading system of Danish higher education:

[https://ufm.dk/en/education/the-danish-education-system/grading-system/karakterer\\_videregaaende\\_en.pdf](https://ufm.dk/en/education/the-danish-education-system/grading-system/karakterer_videregaaende_en.pdf)

### **Software Developer, Ambolt AI ApS (2017 - 2021)**

- Projects: traffic light optimization via stochastic model checking, physician decision support with Bayesian networks.

## Teaching/supervising experience Experience

### **Teaching Assistant in Control Theory, Delft University of Technology (2021 - 2024)**

- Preparing and hosting tutorial sessions for ~100 students
- Updating course materials (code examples and exercises)
- Designing and grading exam questions
- Topics: linear time-invariant systems, state space methods, controllability, observability

### **Supervision, Delft University of Technology (2023 - 2025)**

- Supervising groups of undergraduate students for AI minor final project
- Supervising individual MSc students for thesis projects

## Awards

- Analysis and Design of Hybrid Systems 2024 Young Author Award finalist for the paper "*IntervalMDP.jl: Accelerated Value Iteration for Interval Markov Decision Processes*", Frederik Baymler Mathiesen, Morteza Lahijanani, and Luca Laurenti.
- Delft Center for Systems and Control 2024 Outstanding TA Award for the course "*Control Theory*".

## Funding

- SIGBED 2025 Student Travel Award (CPS-IOT Week)
- Analysis and Design of Hybrid Systems 2024 Student Travel Grant
- American Control Conference 2022 Student Travel Grant
- Nvidia Academic Hardware Grant 2022
- Spar Nord Foundation Spring 2020 Fintech Scholarship

## Membership of Professional Societies

- IEEE incl. IEEE Control Systems Society (2022 - present)
- Association of Computing Machinery (2024 - present)

## Software Tools

- [IntervalMDP.jl](#): hardware-accelerated robust value iteration for Interval Markov Decision Processes (IMDPs) and factored IMDPs (fIMDPs) [Julia].

- [IntervalMDPAbstractions.jl](#): formal verification and control synthesis of stochastic hybrid systems via symbolic-numeric abstractions to IMDPs and fIMDPs, value iteration, and controller refinement via simulation relations [Julia].
- [bound propagation](#): Linear Bound Propagation techniques (CROWN) for linear relaxations of non-linear functions including neural networks [Python].

## Referees

Prof. Luca Laurenti, Delft Center for Systems and Control, Delft Center for Systems and Control, Delft University of Technology, [l.laurenti@tudelft.nl](mailto:l.laurenti@tudelft.nl) - relation: PhD supervisor.

Prof. Manuel Mazo Espinosa, Delft Center for Systems and Control, Delft Center for Systems and Control, Delft University of Technology, [m.mazo@tudelft.nl](mailto:m.mazo@tudelft.nl) - relation: promotor.

## Publications

### Journal papers

[1] Mathiesen, F. B., Romao, L., Calvert, S. C., Laurenti, L., & Abate, A. (2026). A data-driven approach for safety quantification of non-linear stochastic systems with unknown additive noise distribution. Accepted for *Automatica*, available on arXiv:2410.06662.

[2] Mazouz, R., Mathiesen, F. B., Laurenti, L., & Lahijanian, M. (2026). Piecewise Stochastic Barrier Functions. Accepted for *Automatica*, available on arXiv:2404.16986.

[3] Schumann, J. F., Hagenus, J., Mathiesen, F. B., & Zgonnikov, A. (, 2026). Realistic Adversarial Attacks for Robustness Evaluation of Trajectory Prediction Models via Future State Perturbation. In *Journal on Autonomous Transportation Systems*.

[4] Mathiesen, F. B., Calvert, S. C., & Laurenti, L. (2022). Safety certification for stochastic systems via neural barrier functions. *IEEE Control Systems Letters*, 7, 973-978.

### Conference papers

[5] Vertovec, N., Mathiesen, F. B., Badings, T., Laurenti, L., & Abate, A. (2026). Scalable Verification of Neural Control Barrier Functions Using Linear Bound Propagation. Accepted for L4DC 2026, available on arXiv:2511.06341.

[6] Mathiesen, F. B., Vertovec, N., Fabiano, F., Laurenti, L., & Abate, A. (2025). Certified Neural Approximations of Nonlinear Dynamics. Under review, available on arXiv:2505.15497.

[7] Mathiesen, F. B., Haesaert, S., & Laurenti, L. (2025). Scalable control synthesis for stochastic systems via structural IMDP abstractions. In *Proceedings of the 28th ACM International Conference on Hybrid Systems: Computation and Control* (pp. 1-12).

- [8] Mazouz, R., Skovbekk, J., Mathiesen, F. B., Frew, E., Laurenti, L., & Lahijanian, M. (2024). Data-driven permissible safe control with barrier certificates. In *2024 IEEE 63rd Conference on Decision and Control (CDC)* (pp. 6844-6849). IEEE.
- [9] Wang, X., Knodler, L., Mathiesen, F. B., & Alonso-Mora, J. (2024). Simultaneous synthesis and verification of neural control barrier functions through branch-and-bound verification-in-the-loop training. In *2024 European Control Conference (ECC)* (pp. 571-578). IEEE.
- [10] Hagenus, J., Mathiesen, F. B., Schumann, J. F., & Zgonnikov, A. (2024). Robustness in trajectory prediction for autonomous vehicles: a survey. In *2024 IEEE Intelligent Vehicles Symposium (IV)* (pp. 969-976). IEEE.
- [11] Mathiesen, F. B., Lahijanian, M., & Laurenti, L. (2024). IntervalMDP. jl: Accelerated Value Iteration for Interval Markov Decision Processes. In *2024 Analysis and Design of Hybrid Systems (ADHS)*. IFAC.
- [12] Mathiesen, F. B., Romao, L., Calvert, S. C., Abate, A., & Laurenti, L. (2023). Inner approximations of stochastic programs for data-driven stochastic barrier function design. In *2023 62nd IEEE Conference on Decision and Control (CDC)* (pp. 3073-3080). IEEE.
- [13] Mathiesen, F. B., Yang, B., & Hu, J. (2022). Hyperverlet: A symplectic hypersolver for Hamiltonian systems. In *Proceedings of the AAAI Conference on Artificial Intelligence* (Vol. 36, No. 4, pp. 4575-4582).

## Peer reviewing activities

### **Conferences**

- CAV 2026
- CDC 2026, 2025, 2024, 2023
- ECC 2026, 2025
- HSCC 2026
- HSCC Repeatability Evaluation 2026, 2025, 2024
- ICML 2025
- ICTAI 2025
- IFAC WC 2026
- ITSC 2026
- L4DC 2025, 2024

### **Journals**

- JAIR 2026, 2025
- Automatica 2026, 2025
- IEEE Transactions on Automatic Control 2025
- Control System Letters 2026, 2025, 2023

- Artificial Intelligence 2022