Mattia Piccinini

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Research Interests

My research develops autonomous **robotic systems** that can reason, plan, and act in uncertain real-world environments, under physical constraints and safety requirements. While AI has enabled robots to learn complex tasks from data, purely data-driven approaches often lack interpretability, require large datasets, and fail to guarantee safe, reliable behavior. I aim to bridge this gap by combining **physics-informed** knowledge and structured **optimization** principles with **machine learning**, producing planning and control methods that are **data-efficient**, adaptive, and safety-aware. I couple methodological advances with **real-world** validation on robotic platforms, targeting practical impact on the next-generation autonomous systems.

Education

11/2019 – 04/2024 — **Ph.D. in Autonomous Systems**, University of Trento, Italy
Doctorate awarded with highest distinction (*summa cum laude*)
Ph.D. thesis: *Artificial Drivers for Online Time-Optimal Vehicle Trajectory Planning and Control* [pdf].
Supervisor: Prof. Francesco Biral
Date of the defense: 12/04/2024

09/2017 – 10/2019 — **M.Sc. in Mechatronics Engineering**, University of Trento, Italy
Final grade: 110/110 *summa cum laude*
GPA: 30/30, 80% exams with maximum score, 60% exams passed with honors
Thesis: *Path planning and control of self-driving vehicles at the limits of handling* [pdf].

09/2014 – 09/2017 — **B.Sc. in Industrial Engineering**, University of Trento, Italy
Final grade: 110/110 *summa cum laude*
GPA: 30/30, 90% exams with maximum score, 60% exams passed with honors
Thesis: *Degradation of glycol-based cooling fluids causing corrosion in machine tools refrigeration circuits*. The thesis was carried out in cooperation with the companies Pama S.p.A. and Rittal GmbH.

09/2009 – 06/2014 — **Scientific High School Diploma**
Liceo Scientifico A. Rosmini, Rovereto, Italy
Final grade: 100/100

Research Experience

02/2026 – present — **Humboldt Post-doctoral Fellow**
Technical University of Munich, Munich, Germany
Supervisor: Prof. Johannes Betz
Type of contract: Post-doctoral Fellowship

12/2024 – 01/2026 — **TUM Global Post-doctoral Fellow**
Technical University of Munich, Munich, Germany
Supervisor: Prof. Johannes Betz
Type of contract: Post-doctoral Fellowship

Research Experience (continued)

04/2024 – 11/2024 **Post-doctoral Researcher**
University of Trento, Trento, Italy
Supervisor: Prof. Francesco Biral
Type of contract: Assegno di ricerca (Italian research grant)

03/2022 – 06/2022 **Visiting Ph.D. Student**
Universität der Bundeswehr, Munich, Germany
Supervisor: Prof. Matthias Gerdts

11/2019 – 04/2024 **Ph.D. Student**
University of Trento, Trento, Italy
Supervisor: Prof. Francesco Biral
Types of contracts: 11/2019 – 01/2023: Borsa di dottorato (Italian Ph.D. scholarship); 02/2023 – 04/2024: Assegno di ricerca (Italian research grant)

Teaching and Supervision Experience

06/2026 **Lecturer**, Doctoral School in Materials, Mechatronics and Systems Engineering, University of Trento, Italy
Ph.D. course *Physics-informed Machine Learning for Modeling, Planning, Control and Estimation of Physical Systems*.
- Lecturer for all lectures (15 hours).
- Preparation of all course materials.
- Final exam preparation and evaluation.

07/2025 – present **Lecturer**, Technical University of Munich, Germany
Master course *Autonomous Vehicles: Motion Planning and Decision Making*
- Preparation of slides and materials for selected lectures.
- Lecturer (20 hours).
- Support with exam preparation and correction (4 exam sessions).

Lecturer, Technical University of Munich, Germany
Master course *F1TENTH: Autonomous Driving Hands-on*
- Preparation of slides and materials for selected lectures.
- Lecturer (8 hours).

Teaching Assistant, Technical University of Munich, Germany
Master course *Ethical Robot Systems*
- Support with exam preparation and correction (5 exam sessions).

09/2021 – 02/2022
09/2020 – 02/2021
11/2019 – 02/2020 **Lecturer**, EIT Digital Master School, University of Trento, Italy
Master course *Vehicle Dynamics, Planning and Control of Robotic Cars*.
- Building the course from scratch for the first edition in 2019.
- 150+ hours of materials preparation.
- Preparation of all the lecture slides and assignments.
- Holding lectures and exercise sessions (50 hours).
- Exam preparation and correction (6 exam sessions).

03/2025 – 03/2026 **Program Assistant**, Robotics Institute Germany, Germany
Assistance in the creation of a new Master of Science in AI-based Robotics across different universities in Germany.
- Definition of requirements from the industry and research community.
- Survey-based analysis of strengths and weaknesses of the current academic educational landscape in robotics.

Teaching and Supervision Experience (continued)

2025 – present
Thesis Co-Supervisor, Technical University of Munich, Germany
- 5 Ph.D. Students (ongoing), day-to-day supervision, co-advised with Prof. Johannes Betz
- 5 Visiting Ph.D. Students (3 completed, 2 ongoing), day-to-day supervision, co-advised with Prof. Stefania Santini (1), Prof. Flavio Farroni (1), Prof. Aldo Sorniotti (1), Prof. Francesco Biral (1), Prof. Basilio Lenzo (1)
- 4 Visiting Master Students (completed), day-to-day supervision, co-advised with Prof. Alessandro Farinelli (1), Prof. Giulio Panzani (1), Prof. Stefano Arrigoni (1), Prof. Aldo Sorniotti (1)
- 1 Master Student (completed), day-to-day supervision, co-advised with Prof. Johannes Betz and Dingrui Wang
- 2 Semester Thesis Student (ongoing), day-to-day supervision, co-advised with Prof. Johannes Betz

Student Assistant Supervisor, Technical University of Munich, Germany
- 1 Student Assistant hired for 2 months (completed)

2019 – present
Thesis Co-Supervisor, University of Trento, Italy
- 2 Ph.D. Students (ongoing), co-advised with Prof. Francesco Biral (1) and with Prof. Gastone Pietro Rosati Papini (1)
- 9 Master Students (completed), day-to-day supervision, co-advised with Prof. Francesco Biral (6) and with Prof. Gastone Pietro Rosati Papini (3)

2021 – 2022
Thesis Co-Supervisor, EIT Digital Master School (EU)
- 1 Term Project Student (completed), day-to-day supervision, co-advised with Prof. Gastone Pietro Rosati Papini

2020 – 2021
Thesis Co-Supervisor, HAN University of Applied Sciences, Netherlands
- 1 Master Student (completed), day-to-day supervision, co-advised with Prof. Francesco Biral

Work Experience

09/2018 – 06/2019
Control and Simulation Engineer (Student)
Formula SAE Project, Dynamics and Modeling Team, University of Trento, Italy
- Development of vehicle multibody models to validate vehicle controllers.
- Parameter optimization for the mechatronic powertrain.

09/2017 – 07/2018
Mechanical Design Engineer (Student)
Formula SAE Project, Powertrain Design Team, University of Trento, Italy
- Responsible for the mechanical transmission unit.

06/2016 – 08/2017
Cooling System Engineer (Student)
Formula SAE Project, Cooling System Design Team, University of Trento, Italy
- Design and manufacturing of the cooling system for an electric FSAE vehicle.

08/2018 – 09/2018
Engineering Internship
Pama S.p.A., Rovereto (Italy)
- Design of innovative solutions for the kinematic chain in a large-scale, high-precision milling machine divider.

09/2016
Engineering Internship
Pama S.p.A., Rovereto (Italy)
- Experimental setup to investigate corrosion phenomena arising from the degradation of glycol-based cooling fluids within machine tool circuits.

Work Experience (continued)

02/2016
09/2015
02/2015

Engineering Internship
Pama S.p.A., Rovereto (Italy)

- Design and analysis of mechanical and hydraulic assemblies for large-scale high-precision milling and boring machine tools.

Publications and Patents

Metric	Value
N. journal papers	15
N. conference papers	23
N. patents	2 (1 pending)
N. citations (Google Scholar)	550+
h-index (Google Scholar)	13

Peer-Reviewed Journal Papers

J15 T. Schreiter, **M. Piccinini**, J. Dittes, L. Küssel, J. Betz, and A. J. Lilienthal, "Robotics master's education in germany: National landscape and coordination pathways," *IEEE Access*, vol. 14, pp. 124 537–124 549, 2026. DOI: 10.1109/ACCESS.2026.3722349

J14 M. Piazza, A. Langmann, F. Biral, J. Betz, and **M. Piccinini**, "Beyond the apex: Online minimum-time velocity planning on three-dimensional paths with variable friction," *IEEE Robotics and Automation Letters*, vol. 11, no. 8, pp. 10 034–10 041, 2026. DOI: 10.1109/LRA.2026.3707351

J13 A. Mungiello, F. Jahncke, S. Santini, J. Betz, G. P. R. Papini, and **M. Piccinini**, "Vehicle dynamics learning from physics priors with model-structured neural networks," *IEEE Open Journal of Intelligent Transportation Systems*, vol. 7, pp. 1181–1196, 2026. DOI: 10.1109/OJITS.2026.3685078

J12 S. Goblirsch, **M. Piccinini**, J. Betz, and M. Lienkamp, "Multidirectional gaussian-process tire models for kalman filtering in vehicle dynamics state estimation," *Vehicle System Dynamics*, pp. 1–29, 2026. DOI: 10.1080/00423114.2026.2665407

J11 A. Langmann, S. Kohl, L. Ögretmen, **M. Piccinini**, and J. Betz, "A multi-stage time-variant motion planner for agile autonomous driving maneuvers," *IEEE Open Journal of Intelligent Transportation Systems*, vol. 7, pp. 1136–1150, 2026. DOI: 10.1109/OJITS.2026.3686916

J10 Y. Gao, **M. Piccinini**, Y. Zhang, D. Wang, K. Moller, R. Brusnicki, B. Zarrouki, A. Gambi, J. F. Totz, K. Storms, S. Peters, A. Stocco, B. Alrifaee, M. Pavone, and J. Betz, "Foundation models in autonomous driving: A survey on scenario generation and scenario analysis," *IEEE Open Journal of Intelligent Transportation Systems*, pp. 1–1, 2026. DOI: 10.1109/OJITS.2026.3660686

J9 M. Piazza, **M. Piccinini**, S. Taddei, F. Biral, and E. Bertolazzi, "Real-time velocity profile optimization for time-optimal maneuvering with generic acceleration constraints," *IEEE Robotics and Automation Letters*, vol. 11, no. 2, pp. 1674–1681, 2026. DOI: 10.1109/LRA.2025.3643297

J8 F. Jahncke, B. Zarrouki, **M. Piccinini**, J. D'sa, D. Isele, S. Bae, and J. Betz, "Differentiable weights-varying nonlinear mpc via gradient-based policy learning: An autonomous vehicle guidance example," *IEEE Robotics and Automation Letters*, vol. 11, no. 3, pp. 3724–3731, 2026. DOI: 10.1109/LRA.2026.3662644

J7 **M. Piccinini**, S. Taddei, E. Pagot, E. Bertolazzi, and F. Biral, "How optimal is the minimum-time manoeuvre of an artificial race driver?" *Vehicle System Dynamics*, vol. 63, no. 12, pp. 2213–2240, 2025. DOI: 10.1080/00423114.2024.2407176

J6 **M. Piccinini**, M. Zumerle, J. Betz, and G. Pietro Rosati Papini, "A road friction-aware anti-lock braking system based on model-structured neural networks," *IEEE Open Journal of Intelligent Transportation Systems*, vol. 6, pp. 522–536, 2025. DOI: 10.1109/OJITS.2025.3563347

J5 **M. Piccinini**, S. Gottschalk, M. Gerdts, and F. Biral, "Computationally efficient minimum-time motion primitives for vehicle trajectory planning," *IEEE Open Journal of Intelligent Transportation Systems*, vol. 5, pp. 642–655, 2024. DOI: 10.1109/OJITS.2024.3476540

J4 **M. Piccinini**, S. Taddei, M. Larcher, M. Piazza, and F. Biral, "A physics-driven artificial agent for online time-optimal vehicle motion planning and control," *IEEE Access*, vol. 11, pp. 46 344–46 372, 2023. DOI: 10.1109/ACCESS.2023.3274836

J3 M. D. Lio, **M. Piccinini**, and F. Biral, "Robust and sample-efficient estimation of vehicle lateral velocity using neural networks with explainable structure informed by kinematic principles," *IEEE Transactions on Intelligent Transportation Systems*, pp. 1–15, 2023. DOI: 10.1109/TITS.2023.3303776

J2 **M. Piccinini**, M. Larcher, E. Pagot, D. Piscini, L. Pasquato, and F. Biral, "A predictive neural hierarchical framework for on-line time-optimal motion planning and control of black-box vehicle models," *Vehicle System Dynamics*, vol. 61, no. 1, pp. 83–110, 2023. DOI: 10.1080/00423114.2022.2035776 eprint: https://doi.org/10.1080/00423114.2022.2035776.

J1 E. Pagot, **M. Piccinini**, E. Bertolazzi, and F. Biral, "Fast planning and tracking of complex autonomous parking maneuvers with optimal control and pseudo-neural networks," *IEEE Access*, vol. 11, pp. 124 163–124 180, 2023. DOI: 10.1109/ACCESS.2023.3330431

Peer-Reviewed Journal Papers *Under Review*

JR3 **M. Piccinini**, L. Schulze, A. Plebe, M. Saveriano, T. Beckers, Y. Gao, O. Arenz, B. Zarrouki, D. Wang, F. R. Schäfer, J. Peters, J. Betz, and G. P. Rosati Papini, "Embedding physics priors in robot learning: A survey," *The International Journal of Robotics Research*, 2026, under review. URL: https://arxiv.org/abs/2609.22319

JR2 Z. Li, F. Zhao, **M. Piccinini**, B. Zarrouki, Y. Gao, Z. Shan, J. Betz, C. Lv, and L. Xie, "Sgtp: Sampling-based game-theoretic planning for real-time multi-vehicle autonomous racing," *IEEE Robotics and Automation Letters*, 2026, under review.

JR1 Z. Li, B. Zhou, **M. Piccinini**, C. Hu, B. Zarrouki, R. Mangharam, and L. Xie, "Evo-mpcc: Enhanced velocity optimization with learning-based auto-tuning for real-time vehicle trajectory planning," *Control Engineering Practice*, 2026, under review.

Peer-Reviewed Conference Papers

C23 **M. Piccinini**, P. Zambiasi, A. Mungiello, M. Piazza, F. Jahncke, and J. Betz, "Trajectory planning and control near the limits: An open experimental benchmark on the roboracer platform," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C22 Y. Gao, S. Müller, **M. Piccinini**, M. Kaufeld, Y. Zhang, F. R. Schäfer, Q. Song, and J. Betz, "Plannerforge: Llm agents for scenario-based testing of motion planners in autonomous driving," in *2026 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, accepted, 2026.

C21 D. Wang, Z. Liang, H. Ye, Z. Sun, Z. Lu, Y. Zhang, Y. Zhao, Y. Gao, M. Seegert, F. Schäfer, H. Qin, W. Li, L. Palmieri, F. Jahncke, **M. Piccinini**, and J. Betz, "Target-bench: Can video world models achieve mapless path planning with semantic targets?" In *Computer Vision – ECCV 2026*, Cham: Springer Nature Switzerland, 2026, pp. 408–424, ISBN: 978-3-032-37092-1.

C20 F. R. Schäfer, Y. Gao, D. Wang, T. Stauner, G. Stephan, **M. Piccinini**, S. Schmidt, and J. Betz, "Egodyn-bench: Evaluating ego-motion understanding in vision-centric foundation models for autonomous driving," in *Computer Vision – ECCV 2026*, Cham: Springer Nature Switzerland, 2026, pp. 688–705, ISBN: 978-3-032-37321-2.

C19 Y. Gao, W. Miao, **M. Piccinini**, H. Wang, Q. Song, and J. Betz, "Chat2scenic: An iterative rag-based framework for scenario generation in autonomous driving," in *2026 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, accepted, 2026.

C18 K. Moller, R. Stroop, **M. Piccinini**, A. Langmann, and J. Betz, "Learning to sample: Reinforcement learning-guided sampling for autonomous vehicle motion planning," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C17 A. Langmann, F. P. de Araujo, **M. Piccinini**, and J. Betz, "A hybrid sampling-based trajectory planner with game-theoretic guidance for autonomous racing," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C16 G. Jank, **M. Piccinini**, S. Wenk, P. Pitschi, J. Betz, and B. Lohmann, "Benchmarking empirical and learning-based approaches for feedforward steering control in autonomous racing," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C15 A. Schwehn, A. Langmann, **M. Piccinini**, and J. Betz, "Control-informed constraint adaptation in minimum-time trajectory planning for autonomous racing," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C14 R. Brusnicki, **M. Piccinini**, and J. Betz, "How well do vision-language models understand sequential driving scenes? a sensitivity study," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C13 R. Brusnicki, D. Pop, Y. Gao, **M. Piccinini**, and J. Betz, "Can vlms unlock semantic anomaly detection? a framework for structured reasoning," in *2026 IEEE 29th International Conference on Intelligent Transportation Systems (ITSC)*, accepted, 2026.

C12 Y. Gao, **M. Piccinini**, R. Brusnicki, Y. Zhang, and J. Betz, "Nurisk: A visual question answering dataset for agent-level risk assessment in autonomous driving," in *2026 IEEE International Conference on Robotics and Automation (ICRA)*, accepted, 2026.

C11 **M. Piccinini**, S. Taddei, J. Betz, and F. Biral, "Kineto-dynamical planning and accurate execution of minimum-time maneuvers on three-dimensional circuits," in *2025 IEEE International Conference on Robotics and Automation (ICRA)*, 2025, pp. 1–7. DOI: 10.1109/ICRA55743.2025.11127446

C10 M. Kaufeld, **M. Piccinini**, and J. Betz, "Mp-rbfn: Learning-based vehicle motion primitives using radial basis function networks," in *2025 IEEE 28th International Conference on Intelligent Transportation Systems (ITSC)*, 2025, pp. 1262–1269. DOI: 10.1109/ITSC60802.2025.11423753

C9 Y. Gao, **M. Piccinini**, K. Moller, A. Alanwar, and J. Betz, "From words to collisions: Llm-guided evaluation and adversarial generation of safety-critical driving scenarios," in *2025 IEEE 28th International Conference on Intelligent Transportation Systems (ITSC)*, 2025, pp. 2134–2141. DOI: 10.1109/ITSC60802.2025.11423486

C8 **M. Piccinini**, A. Mungiello, G. Jank, G. P. R. Papini, F. Biral, and J. Betz, "Model-structured neural networks to control the steering dynamics of autonomous race cars," in *2025 IEEE 28th International Conference on Intelligent Transportation Systems (ITSC)*, 2025, pp. 4129–4136. DOI: 10.1109/ITSC60802.2025.11423721

C7 F. Werner, S. Sagmeister, **M. Piccinini**, and J. Betz, "A quasi-steady-state black box simulation approach for the generation of g-g-g-v diagrams," in *2025 IEEE Intelligent Vehicles Symposium (IV)*, 2025, pp. 2503–2509. DOI: 10.1109/IV64158.2025.11097491

C6 B. Zhou, B. Zarrouki, **M. Piccinini**, C. Hu, L. Xie, and J. Betz, "Safe reinforcement learning with a predictive safety filter for motion planning and control: A drifting vehicle example," in *2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2025, pp. 4196–4203. DOI: 10.1109/IROS60139.2025.11246272

C5 S. Taddei, **M. Piccinini**, and F. Biral, "Biasing the driving style of an artificial race driver for online time-optimal maneuver planning," in *2025 IEEE Intelligent Vehicles Symposium (IV)*, 2025, pp. 640–647. DOI: 10.1109/IV64158.2025.11097381

C4 S. Gottschalk, M. Gerdts, and **M. Piccinini**, "Reinforcement learning and optimal control: A hybrid collision avoidance approach," in *Proceedings of the 10th International Conference on Vehicle Technology and Intelligent Transport Systems - VEHITS*, INSTICC, SciTePress, 2024, pp. 76–87, ISBN: 978-989-758-703-0. DOI: 10.5220/0012569800003702

C3 M. Piazza, **M. Piccinini**, S. Taddei, and F. Biral, "Mptree: A sampling-based vehicle motion planner for real-time obstacle avoidance," in *17th IFAC Symposium on Control in Transportation Systems (CTS), IFAC-PapersOnLine*, vol. 58, 2024, pp. 146–153. DOI: https://doi.org/10.1016/j.ifacol.2024.07.332

C2 **M. Piccinini**, S. Taddei, M. Piazza, and F. Biral, "Impacts of g-g-v constraints formulations on online minimum-time vehicle trajectory planning," in *17th IFAC Symposium on Control in Transportation Systems (CTS), IFAC-PapersOnLine*, vol. 58, 2024, pp. 87–93. DOI: https://doi.org/10.1016/j.ifacol.2024.07.323

C1 E. Pagot, **M. Piccinini**, and F. Biral, "Real-time optimal control of an autonomous rc car with minimum-time maneuvers and a novel kineto-dynamical model," in *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2020, pp. 2390–2396. DOI: 10.1109/IROS45743.2020.9340640

Peer-Reviewed Workshop Papers

W13 F. Jahncke, B. Zarrouki, **M. Piccinini**, J. D'sa, D. Isele, S. Bae, and J. Betz, "Gradient-based policy learning for context-aware differentiable weights-varying nonlinear mpc," in *Conference AUTOMATICA.IT*, 2026.

W12 C. Oefinger, F. R. Schäfer, K. Moller, **M. Piccinini**, and J. Betz, "Validate the dream before you trust its verdict: Admissibility for world-model simulators," in *Workshop Robot World Models, RSS Conference*, 2026.

W11 Y. Gao, W. Miao, **M. Piccinini**, H. Wang, Q. Song, and J. Betz, "Chat2scenic: An iterative rag-based framework for scenario generation in autonomous driving," in *Workshop DriveX at the 19th European Conference on Computer Vision (ECCV)*, 2026.

W10 M. Piazza, **M. Piccinini**, S. Taddei, F. Biral, and E. Bertolazzi, "Fast and flexible velocity planning for time-optimal maneuvers," in *Workshop on Frontiers of Optimization for Robotics, IEEE International Conference on Robotics and Automation (ICRA)*, 2026.

W9 M. Piazza, **M. Piccinini**, S. Taddei, F. Biral, and E. Bertolazzi, "Fbga: A forward-backward method for online time-optimal velocity planning with generic acceleration constraints," in *2nd German Robotics Conference*, 2026. URL: https://www.mos.ed.tum.de/fileadmin/w00ccp/avs/_my_direct_uploads/Mattia.pdf

W8 R. Brusnicki, **M. Piccinini**, and J. Betz, "Bridging the loco-manipulation disconnect: Dynamic whole-body impulse control on floating-base robots," in *2nd German Robotics Conference*, 2026. URL: https://www.mos.ed.tum.de/fileadmin/w00ccp/avs/_my_direct_uploads/Roberto.pdf

W7 Y. Gao, **M. Piccinini**, and J. Betz, "Towards whole-body vla: A scalable data collection framework for quadrupedal mobile manipulators," in *2nd German Robotics Conference*, 2026. URL: https://www.mos.ed.tum.de/fileadmin/w00ccp/avs/_my_direct_uploads/Yuan.pdf

W6 **M. Piccinini**, M. Zumerle, J. Betz, and G. P. R. Papini, "Model-structured neural networks for road friction-aware anti-lock braking systems," in *Conference AUTOMATICA.IT*, 2025.

W5 S. Taddei, **M. Piccinini**, and F. Biral, "From early to late apexes: Biasing the driving style of online time-optimal maneuver planning," in *Conference AUTOMATICA.IT*, 2025.

W4 **M. Piccinini**, S. Gottschalk, M. Gerdts, and F. Biral, "Neural motion primitives for online time-optimal vehicle trajectory planning," in *Conference AUTOMATICA.IT*, 2024.

W3 S. Taddei, **M. Piccinini**, E. Pagot, and F. Biral, "Artificial racing coach: Teaching humans how to maximize a racing vehicle's performance and drive at its limits," in *Conference AUTOMATICA.IT*, 2024.

W2 **M. Piccinini**, S. Taddei, M. Larcher, M. Piazza, and F. Biral, "A physics-driven framework for online minimum-time vehicle motion planning and control," in *Conference AUTOMATICA.IT*, 2023.

W1 E. Pagot, **M. Piccinini**, A. Plebe, E. Bertolazzi, and F. Biral, "Real-time autonomous parking in unstructured scenarios with an indirect optimal control approach," in *Workshop Behavior-Driven Autonomous Driving in Unstructured Environments (BADUE), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2022. URL: `https://obj.umiacs.umd.edu/badue-accepted/8.pdf`

Other Publications

O1 **M. Piccinini** and S. Mariano, "Localization and control of autonomous vehicles in an urban intersection scenario," 2019. URL: `https://www.researchgate.net/publication/334945954_Localization_and_Control_of_Autonomous_Vehicles_in_an_Urban_Intersection_Scenario`

Poster Sessions

PS4 **M. Piccinini**, A. Mungiello, J. Betz, and G. P. R. Papini, "Model-Structured Neural Networks to Model & Control Robots", *Late-Breaking Results Poster Session*, International Conference on Robotics and Automation (ICRA), Atlanta, USA, 2025.

PS3 **M. Piccinini**, S. Taddei, and F. Biral, "Artificial Race Driver", *Poster Session at the Industrial Engineering Day*, University of Trento, 2023.

PS2 **M. Piccinini**, E. Pagot, and S. Taddei, "Virtual Driver to Control Race Cars near the Limits", *PhDII Poster Session*, University of Trento, 2022.

PS1 M. Piazza and **M. Piccinini**, "MPTree: Motion Primitive Tree Exploration for Trajectory Planning with Dynamic Obstacle Avoidance", *Poster Session at the Industrial Engineering Day*, University of Trento, 2022.

Patents

PT2 F. Jahncke, B. Zarrouki, **M. Piccinini**, J. D'sa, D. Isele, S. Bae, and J. Betz, "Differentiable Weights-Varying Nonlinear MPC via Gradient-Based Policy Learning: An Autonomous Vehicle Guidance Example", Patent pending, 2026.

PT1 M. D. Lio, F. Biral, and **M. Piccinini**, "Device and method, based on neural networks, for estimating the lateral speed of vehicles", WO2023166536A1, 2023. URL: `https://patents.google.com/patent/WO2023166536A1/en?oq=PCT%2fIT2023%2f050058`

Awards & Funding

09/2026 **Best Workshop Paper Award**
Paper [C21], 2026 European Conference on Computer Vision (ECCV), Workshop on World Models in the Loop: Towards Application-Driven World Model Evaluation.

Awards & Funding (continued)

08/2026 **Best Student Paper Award Finalist**
Paper [C13], 2026 IEEE International Conference on Intelligent Transportation Systems (ITSC).

06/2026 **Huawei X TUM MIRMI Joint Lab Call**
1 fully-funded Ph.D. position for 24 months, following the evaluation of a research proposal.

02/2026 **Seal of Excellence for Marie Skłodowska-Curie Post-doctoral Fellowship**
Project evaluation: 90.6% (Seal of Excellence). Not funded due to budget limitations.

12/2025 **Humboldt Post-doctoral Fellowship**
2-year funding for post-doctoral researchers, following the evaluation of a research proposal (**success rate** $< 20\%$).

11/2025 **Best Poster Award**
German Autonomy Summit, Munich (Germany), 2025 (3^{rd} place).

10/2025 **Best Workshop Paper Award**
Paper [C8], also presented at the 2025 IEEE IROS conference, Workshop on Planning, Perception and Navigation for Intelligent Vehicles.

09/2025 **Best Ph.D. Thesis Award**
Issued by the journal *MDPI Vehicles*.

08/2025 **IEEE ITSS Best Dissertation Award**
Issued by the IEEE Intelligent Transportation Systems Society. The related article, published in the IEEE ITS Magazine, is available here.

07/2025 **IEEE IES-SYPA Travel Award**
Issued by the IEEE Industrial Electronics Society (IES) for participation in the 2025 IEEE IROS conference (**success rate** $< 10\%$).

06/2025 **Best Paper Award Finalist**
Paper [C7], 2025 IEEE Intelligent Vehicles (IV) Symposium.

03/2025 **EuroTech Visiting Researcher Award**
15-day research travel grant to collaborate with the Eindhoven University of Technology, following a competitive selection of a research proposal.

12/2024 **TUM Global Post-doctoral Fellowship**
2-year funding for early-career researchers, following the evaluation of a research proposal (10 funded positions, **success rate** $< 10\%$).

07/2024 **IFAC Young Author Award**
Paper [C2], awarded at the 17^{th} IFAC Symposium on Control in Transportation Systems, Cyprus.

05/2024 **Best Paper Award Finalist**
Paper [C4], 10^{th} International Conference on Vehicle Technology and Intelligent Transport Systems (VEHITS).

04/2024 **Ph.D. Graduation with Highest Distinction** (*summa cum laude*)

11/2023 **Best Poster Award**
Industrial Engineering Day, University of Trento (Italy).

10/2019 **M.Sc. Graduation with Highest Distinction** (*summa cum laude*)

09/2017 **B.Sc. Graduation with Highest Distinction** (*summa cum laude*)

Projects

11/2026 – present

6G-Enabled Distributed Intelligence for Humanoid Robots: From Split-Brain Architectures to Collaborative Multi-Agent Perception
Project funded by the Huawei X TUM MIRMI Joint Lab Call.
Responsibilities: Scientific co-lead: research proposal writing and co-supervision of 1 funded Ph.D. student.

02/2026 – present

Boosting Robot Performance with Model-Based and Data-Driven Control
Project funded by the Alexander von Humboldt Foundation (Germany) as part of the Humboldt Postdoctoral Fellowship, following a competitive selection process.
Responsibilities: P.I. (proposal author; scientific lead; project development; reporting). Co-supervision of 1 Ph.D. student and 3 visiting researchers contributing to the project's research lines (funded through other sources).
Outputs: 2 journal papers [J13], [JR3], 2 conference papers [C23], [C16].

05/2025 – present

Modular Software Stacks for Autonomous Driving
Industry-funded project, with the Honda Research Institute company (USA).
Responsibilities: Scientific co-lead: technical co-direction of two work packages. Co-supervision of 1 Ph.D. student and 2 Master's students contributing to the project.
Outputs: 1 journal paper [J8], 1 patent [PT2].

03/2025 – 03/2026

Robotics Institute Germany – Education Cluster
Funded by the German Federal Ministry of Research, Technology and Space (BMFTR).
Responsibilities: Involved in one work package on robotics education: Assistance in the creation of a new Master of Science in AI-based Robotics across different universities in Germany; Definition of requirements from the industry and research community; Survey-based analysis of strengths and weaknesses of the current academic educational landscape in robotics.
Outputs: 1 journal paper [J15].

12/2024 – 01/2026

Adaptive Control for Intelligent Vehicles in Challenging Environmental Conditions
Project funded by the Technical University of Munich (Germany) as part of the TUM Global Postdoctoral Fellowship, following a competitive selection process.
Responsibilities: P.I. (proposal author; scientific lead; project development; reporting). Co-supervision of 1 Master's student contributing to the project's research lines.
Outputs: 1 journal paper [J6], 1 conference paper [C8].

01/2024 – 11/2024

Digital Twin Vehicle Models for Energy Management, Performance Optimization and Parameter Estimation
Industry-funded project, with the Stellantis company (Italian division).
Responsibilities: Development and implementation of 4 work packages and final report writing.
Outputs: software package for vehicle digital twin modeling and simulation.

11/2019 – 11/2021

Artificial Drivers of Autonomous Race Cars
Industry-funded project, with the AnteMotion S.r.l. company (Italy).
Responsibilities: Development and implementation of 3 work packages.
Outputs: 3 journal papers [J7], [J4], [J2], 1 conference paper [C1].

Scientific Collaborations

Germany

- **Universität der Bundeswehr München**, Institute of Applied Mathematics and Scientific Computing (Prof. Matthias Gerdts)
  Topics: Neural motion primitives, reinforcement learning and optimal control for motion planning.
  Joint activities: Research visit (03/2022 – 06/2022).
  Joint outputs: 1 journal paper [J5], 1 conference paper [C4].
- **Technical University of Darmstadt**, Intelligent Autonomous Systems Lab (Prof. Jan Peters)
  Topic: Physics-informed robot learning.
  Joint outputs: 1 journal paper [JR3].

USA

- **Stanford University**, Autonomous Systems Lab (Prof. Marco Pavone)
  Topic: Foundation models for scenario generation and analysis in autonomous driving.
  Joint outputs: 1 journal paper [J10].
- **Honda Research Institute USA** (Dr. Sangjae Bae, Dr. David Isele, Dr. Jovin D'sa)
  Topic: Differentiable model predictive control and policy learning for autonomous vehicles.
  Joint outputs: 1 journal paper [J8], 1 patent [PT2].

Netherlands

- **Eindhoven University of Technology (TU/e)**, Control Systems Technology Section (Prof. Mauro Salazar)
  Topic: Optimal control for automated and electrified racing.
  Joint activities: Research visit at TU/e (EuroTech Visiting Researcher Award, 2025).
  Joint outputs: Joint organization of a workshop and an invited session at IEEE ITSC 2026.

China

- **Zhejiang University**, College of Control Science and Engineering (Prof. Lei Xie)
  Topic: Safe reinforcement learning and game-theoretic motion planning.
  Joint activities: Research visit at Zhejiang University (October 2025).
  Joint outputs: 2 journal papers [JR2], [JR1], 1 conference paper [C6].

Singapore

- **Nanyang Technological University**, School of Mechanical and Aerospace Engineering (Prof. Chen Lv)
  Topic: Game-theoretic planning for multi-vehicle autonomous racing.
  Joint outputs: 1 journal paper [JR2].

Italy

- **University of Naples Federico II**, Department of Electrical Engineering and Information Technology, and Department of Industrial Engineering (Prof. Stefania Santini, Prof. Flavio Farroni)
  Topic: Physics-informed neural networks for vehicle dynamics learning, control, and tire temperature modeling.
  Joint activities: Co-supervision of 2 visiting Ph.D. students.
  Joint outputs: 1 journal paper [J13], 2 conference papers [C23], [C8].
- **University of Verona**, Department of Computer Science (Prof. Alessandro Farinelli, Dr. Daniele Meli)
  Topic: Combining AI and control for reliable robot planning.
  Joint activities: Co-supervision of 1 visiting Master student; research visit (2026).
  Joint outputs: Joint organization of a workshop at IEEE/RSJ IROS 2026.
- **Politecnico di Milano**, Department of Mechanics and Department of Electronics, Information and Bioengineering (Prof. Stefano Arrigoni, Prof. Giulio Panzani)
  Topic: Minimum-time motion planning for autonomous racing.
  Joint activities: Co-supervision of 2 visiting Master students.

Scientific Collaborations (continued)

- **Politecnico di Torino**, Department of Mechanical and Aerospace Engineering (Prof. Aldo Sorniotti)
  Topic: Motion planning and control for autonomous vehicles.
  Joint activities: Co-supervision of 1 visiting Ph.D. student and 1 visiting Master student.
  Joint outputs: 1 conference paper [C23].
- **University of Trento**, Department of Industrial Engineering (Prof. Gastone Pietro Rosati Papini, Prof. Matteo Saveriano)
  Topics: Model-structured neural networks for modeling and control of robotic systems.
  Joint activities: Co-supervision of 1 Ph.D. student and 3 Master students (2025 – present).
  Joint outputs: 3 journal papers [J13], [J6], [JR3], 1 conference paper [C8].

Academic Engagement

Editorial Activities

- **Associate Editor**, IEEE Robotics and Automation Letters (RA-L), from 2026
- **Associate Editor**, IEEE International Conference on Robotics and Automation (ICRA), from 2026
- **Associate Editor**, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), from 2026
- **Associate Editor**, IEEE International Conference on Intelligent Transportation Systems (ITSC), from 2026
- **Guest Editor** of the Special Issue on "Methods and Algorithms for Autonomous Systems in Intelligent Transportation", IEEE Open Journal of Intelligent Transportation Systems, from November 2026

Conference Committees

- **Competition Chair** and Member of the **Program Committee** of the IEEE Intelligent Vehicles Symposium (IV), Perth (Australia), 2027
- **Invited Session Organizer**, Invited Session on "Automated Vehicles at the Limits: Lessons and Opportunities from the Racetrack", IEEE International Conference on Intelligent Transportation Systems (ITSC), 2026

Workshop Organization

- **Workshop Organizer**: M. Piccinini, M. Salazar, J. Betz, "Automated and Electrified Racing: Opportunities for Future Intelligent Vehicles", IEEE International Conference on Intelligent Transportation Systems (ITSC), 2026
- **Workshop Organizer**: D. Meli, M. Piccinini, F. Trotti, A. Farinelli, J. Betz, "AI Meets Control for Resilient and Reliable Robot Planning (AIM-Ctrl)", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2026

Session Chairs

- **Chair** of the session "Automated Vehicles at the Limits: Lessons and Opportunities from the Racetrack", at the IEEE International Conference on Intelligent Transportation Systems (ITSC), Naples (Italy), 2026

- **Chair** of the session "Tracking and Coordinating Autonomous Vehicle Fleets", at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Pittsburgh (USA), 2026
- **Chair** of the session "Model Predictive Control", at the Automatica.it conference, Parma (Italy), 2026
- **Chair** of the session "Path Planning", at the Automatica.it conference, Bolzano (Italy), 2024
- **Co-chair** of the session "Modeling, Control, and Optimization of Transportation Systems", at the 17th IFAC Symposium on Control in Transportation Systems (CTS), Ayia Napa (Cyprus), 2024

Invited Talks

1. Invited talk at the 16th Workshop on Planning, Perception and Navigation for Intelligent Vehicles, 2026 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Pittsburgh, USA: *Differentiable Physics-Informed Learning and Control in Autonomous Vehicle Racing*, 2026
2. Invited talk at the Workshop "Automated Mobility in Mixed Traffic - Toward Robust, Human-Centric, and Trustworthy Systems", IEEE 29th International Conference on Intelligent Transportation Systems (ITSC), Naples, Italy: *From the Lab to the Street: Open-Source Software for Interactive Urban Scenario Driving*, 2026
3. Invited talk at the Workshop "An Introduction to Autoware and Its Application Platforms", IEEE 29th International Conference on Intelligent Transportation Systems (ITSC), Naples, Italy: *Open-Source Autonomy: A Path from Interactive Simulation to Real-World Driving*, 2026
4. Invited talk at the Stellantis company: *Physics-Informed AI for Robotics: Overview and Opportunities*, online invited talk, 2026
5. Invited talk at the University of Verona: *Physics-Encoded Trajectory Planning and Control: From Racing Cars to General Robotics*, 2026
6. Invited talk at Eindhoven University of Technology: *Physics-Guided Motion Generation and Control: From Autonomous Racing Towards General Robotics*, 2025
7. Invited talk at the online Workshop series organized by the Ekumen company: *NNodely: An Open Framework for Model-Structured Neural Networks in Robotics*, 2025, `https://www.youtube.com/watch?v=mz70WepnwMM`
8. Invited talk at the Technical University of Munich: *Artificial Drivers to Learn the Vehicle Dynamics, Plan and Execute Online Time-Optimal Maneuvers*, 2024
9. Invited talk at the University of Trento, Seminar for PhD students: *Model-Structured Neural Networks to Model and Control Physical Systems*, 2024
10. Invited talk at Universität der Bundeswehr, Munich: *Virtual race drivers for planning and control with robotic cars*, 2022

University Service

- **TUM Internationalization** support: organized the research visits of Prof. Basilio Lenzo, Prof. Francesco Biral, Dr. Mattia Laurini, and the visiting Ph.D. students Aniello Mungiello, Gonçalo Torres, Mattia Piazza, and Gianluca Frison to the Technical University of Munich, Professorship of Autonomous Vehicle Systems (2025 – present).
- **Final Examination Committee** Member for around 40 Master's theses at the Technical University of Munich, Professorship of Autonomous Vehicle Systems (2024 – present).
- **Final Examination Committee** Member for around 20 Bachelor's theses at the Technical University of Munich, Professorship of Autonomous Vehicle Systems (2024 – present).

- **Selection Committee Chair** for external visiting Ph.D. positions and M.Sc. theses at the Technical University of Munich, Professorship of Autonomous Vehicle Systems (2025 – present).
- **Open Days** Lab Presenter, Master of Science in Mechatronics Engineering, University of Trento (2020 – 2022).

Society Memberships

- IEEE Robotics and Automation Society (RAS)
- IEEE Intelligent Transportation Systems Society (ITSS)
- Società Italiana dei Docenti e Ricercatori di Automatica (SIDRA)
- German Robotics Society (Deutsche Gesellschaft für Robotik, DGR)

Attendance at Conferences with Oral Presentations

- IEEE International Conference on Intelligent Transportation Systems (ITSC) 2026, Naples (Italy)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2026, Pittsburgh (USA)
- German Robotics Conference 2026, Cologne (Germany)
- Automatica.it 2026, Parma (Italy)
- IEEE International Conference on Robotics and Automation (ICRA) 2025, Atlanta (USA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2025, Hangzhou (China)
- Automatica.it 2025, Perugia (Italy)
- IFAC Symposium on Control in Transportation Systems (CTS) 2024, Ayia Napa (Cyprus)
- Automatica.it 2024, Bolzano (Italy)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020, Las Vegas (USA)

Peer-Review Activities

Journals: IEEE Transactions on Intelligent Transportation Systems; IEEE Transactions on Intelligent Vehicles; IEEE Transactions on Vehicular Technology; IEEE Transactions on Mechatronics; IEEE Transactions on Industrial Electronics; IEEE Open Journal of Control Systems; IEEE Transactions on Control Systems Technology; IEEE Transactions on Robotics; IEEE Robotics and Automation Letters (RA-L); IEEE Access; Robotics and Autonomous Systems; Springer Nature - International Journal of Machine Learning and Cybernetics; Springer Optimization and Engineering; Springer Nature Communications; Control Engineering Practice (IFAC); Vehicle System Dynamics; Mechanical Systems and Signal Processing; Results in Materials (Elsevier); MDPI Vehicles; MDPI Machines; MDPI Electronics; MDPI Actuators; MDPI Algorithms; MDPI Drones; MDPI Symmetry; MDPI Applied Sciences; MDPI World Electric Vehicle Journal

Conferences: IEEE International Conference on Robotics and Automation (ICRA); IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS); IEEE Intelligent Vehicles Symposium (IV); IEEE International Conference on Intelligent Transportation Systems (ITSC); IEEE Conference on Decision and Control (CDC); Conference on Neural Information Processing Systems (NeurIPS); European Control Conference (ECC); IEEE Conference on Control Technology and Applications; IEEE International Conference on Real-time Computing and Robotics; IEEE International Conference on Advanced Motion Control; International Conference on System Theory, Control and Computing (ICSTCC); IFAC Symposium on Control in Transportation Systems; Winter Conference on Applications of Computer Vision (WACV).

Skills

Programming	Matlab, Simulink, Python, C/C++, Maple, Mathematica, Ruby
Machine Learning Frameworks	Tensorflow, Keras, PyTorch
Development Tools	GitHub, GitLab, Bitbucket
CAD Software	SolidWorks, Inventor, AutoCAD
Operating Systems	MacOS, Windows, Linux
Other Computer Skills	LaTeX, Microsoft Word, Microsoft Excel, Microsoft Power-Point, Apple Keynote, Apple Pages
Others	Driving licence B
Languages	English: full professional proficiency (Cambridge Certificate of Advanced English, level C1) German: upper-intermediate knowledge Italian: native

Personal Details and Interests

- Date of birth: 16/07/1995
- Nationality: Italian
- Personal interests: traveling, swimming, hiking

References

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Munich, 25/10/2026



Mattia Piccinini