

prof. Ing. Jan Faigl, Ph.D.

Personal Information

Family name, First name: **Faigl, Jan**

Researcher unique identifier (Researcher ID): E-8685-2013

Website: <http://robotics.fel.cvut.cz/jf>

Google Scholar: https://scholar.google.cz/citations?user=-finD_sAAAAJ&hl=en

Education

- 2010 PhD in Electrical Engineering and Information Technology, Artificial Intelligence and Biocybernetics, Faculty of Electrical Engineering (FEE), Czech Technical University (CTU), Czechia.
- 2003 Ing. (~MSc.) in Electrical Engineering, branch Technical Cybernetics, FEE, CTU.

Current Positions

- 2019–present *Professor* – Department of Computer Science, FEE, CTU.

Previous Positions

- 2015–2019 *Associate Professor* – Department of Computer Science, FEE, CTU.
- 2013–2014 *Assistant Professor* – Department of Computer Science, FEE, CTU.
- 2010–2012 *Assistant Professor* – Department of Cybernetics, FEE, CTU.
- 2003–2012 *Research fellow* – Intelligent and Mobile Robotics Group, Department of Cybernetics, CTU.
- 2011 *Research fellow* – Center for Applied Cybernetics, CTU.
- 2003–2006 *System Analyst and Programmer* (railway safety and diagnostics) – ProTyS, Inc., Czechia.

Fellowships and Awards

- 2023 The Unmanned Ground Systems Autonomy Trials (UGV-AT), Läsna, Estonia.
- 2022 V4 - Innovation Challenge Day 2022 "Military Autonomous Systems."
- 2021 IT SPY – best master thesis in the field of informatics and information technology in Czechia and Slovakia for the supervised master student J. Deckerová.
- 2021 DARPA SubT Challenge Finals - 2nd place in virtual competition.
- 2021 Amazon Research Award for the project *Communication maps building in subterranean environments*.
- 2020 AI Awards 2019, Best project of the year 2019, Czechia.
- 2020 DARPA SubT Challenge - 3rd place in Urban Circuit, Elma, Washington, USA.
- 2019 DARPA SubT Challenge - 3rd place in Tunnel Circuit, Pittsburgh, Pennsylvania, USA.
- 2019 WSOM+ 2019 Best student paper, Barcelona, Spain for the paper *Autoencoders Covering Space as a Life-Long Classifier* of the supervised phd student Rudolf Szadkowski.
- 2019 IT SPY – best master thesis in the field of informatics and information technology in Czechia and Slovakia for the supervised master student J. Bayer.
- 2018 RSS 2018 Best student paper award finalist, Pittsburgh, Pennsylvania, USA, for the paper *Optimal Solution of the Generalized Dubins Interval Problem* of the supervised phd student P. Váňa.
- 2017 Winner team of Challenge No. 3 in Mohamed Bin Zayed International Robotics Challenge (MBZIRC), Abu Dhabi, UAE, <http://mrs.felk.cvut.cz/projects/mbzirc>.
- 2017 IJCNN 2017 Best poster honorable mention, Anchorage, Alaska, USA
- 2016 IROS 2016 RoboCup best paper award finalist, Deajeon, Korea, for the paper *Multi-robot path planning for budgeted active perception with self-organising maps* with G. Best and R. Fitch.
- 2016 Best Poster Award for the Workshop on Self-Organizing Maps (WSOM'16), for the paper *"On Self-Organizing Map and Rapidly-exploring Random Graph in Multi-Goal Planning."*
- 2014 Best Poster Award for the Workshop on Self-Organizing Maps (WSOM'14), for the join paper *"Organizing Map for the Prize-Collecting Traveling Salesman Problem"* with G. Hollinger.
- 2013 Fulbright Scholarship award for six months research stay at the University of Southern California, Robotic Embedded System Laboratory (RESL), Prof. Gaurav Sukhatme
- 2011 Short research stay at University of Pennsylvania, GRASP laboratory, Prof. Vijay Kumar.
- 2011 Antonin Svoboda award from Czech Society for Cybernetics and Informatics for the best Ph.D. dissertation in Czech Republic.

Projects (Principal Investigator)

- 2024–2028 *Robotics and advanced industrial production*, EU funded project by Ministry of Education, Youth, and Sports (MEYS), Project No. CZ.02.01.01/00/22_008/0004590, leader of the research area "RA10 Robotic routing in dynamic human-populated industrial environments."
- 2024–2026 *Situation Awareness Sharing in Human-Machine Interaction using Resilient Communication in Robotics Telemetry*, MEYS, Project No. LUABA24064.
- 2023–2025 *Automated system for critical infrastructure protection using cyber-physical technologies*, Ministry of the Interior of the Czech Republic, Project No. VK01030216.
- 2023–2028 *Center for advanced machines and manufacturing technology*, National Centres of Competence, Technology Agency of Czech Republic, TAČR, Project No. TNO2000028, leader of Advanced robotics subproject.

2022–2024	<i>Towards Optimal Solution of Robotic Routing Problems</i> , Czech Science Foundation (GA ČR), Project No. 22-05762S.
2022–2024	<i>Risk-Aware Trajectory Planning and Optical Image Recognition Assisted Landing System for Fixed-Wing UAVs (RAPALS)</i> , Technology Agency of the Czech Republic (TA ČR), Project No. TM03000046.
2021–2023	<i>Learning Complex Motion Planning Policies</i> , Czech Science Foundation (GA ČR), Project No. 21-33041J; a joint project with J. Baltes, National Taiwan Normal University, Taiwan.
2019–2022	<i>Multi-Robot Persistent Monitoring of Dynamic Environments</i> , Czech Science Foundation (GA ČR), Project No. 19-20238S.
2019–2022	<i>Towards Optimal Curvature-Constrained Tours in Robotic Applications</i> , Ministry of Education Youth and Sports (MEYS) Project No. LTAIZ19013; a joint project with O. Salzman, Technion, Israel.
2018–2020	<i>Robotic Lifelong Learning of Multi-legged Robot Locomotion Control in Autonomous Data Collection Missions</i> , Czech Science Foundation (GA ČR), Project No. GA18-18858S.
2018–2020	<i>Hybrid navigation system for autonomous vehicles in environment with denied GNSS services</i> , Technology Agency of the Czech Republic (TA ČR), Project No. TH03010362.
2016–2018	<i>Efficient Information Gathering with Dubins Vehicles in Persistent Monitoring and Surveillance Missions</i> – Czech Science Foundation (GA ČR), Project No. 16-24206S.
2015–2017	<i>Adaptive Informative Path Planning in Autonomous Data Collection in Dynamic Unstructured Environments</i> – Czech Science Foundation (GA ČR), Junior Research Project No. 15-09600Y.
2014–2015	<i>Multi-Agent Coordination in Robotic Exploration and Reconnaissance Missions</i> , Ministry of Education, Czech Republic, program MOBILITY, Project No. 7AMB14FR019, collaborative project with INRIA Nancy and INSA Lyon, France.
2013–2015	<i>Self-Organizing Maps for Multi-Goal Path Planning Tasks</i> – Czech Science Foundation (GA ČR), Post-doc Research Project No. 13-18316P.

Projects (Co-PI and Team Member)

2018–2203	RCI – <i>Research Center for Informatics</i> , EU and Ministry of Education, Czech Republic, Project No. CZ.02.1.01/0.0/0.0/16_019/0000765; member of the board and co-lead of robotics track.
2020–2022	<i>Autonomous time-critical exploration of communication and perception constrained environment by team of robots</i> , Czech Science Foundation (GA ČR), Project No. 20-29531S.
2020–2021	<i>DARPA Subterranean Challenge - Phase 3</i> , Defense Advanced Research Projects Agency (DARPA), Agreement No. HRO0112190014.
2011–2012	COLOS – <i>Control and Localization for Swarms of Low-cost Autonomous Robots</i> , Ministry of Education, Czech Republic, Project No. LH11053.
2006–2011	SyRoTek – <i>Tele-education System for Robotics</i> – Ministry of Education, Czech Republic, Project No. 2C06005, http://syrotek.felk.cvut.cz .
2003–2005	PeLoTe – <i>Building Presence through Localization for Hybrid Telematic Systems</i> – EU 5FP Project No. IST-2001-38873.

Editor Associate editor of IEEE Transactions on Automation Science and Engineering (2019–2022); Frontiers in Robotics and AI (since 2022); Guest editor of the *Field Robotics* journal for the special issue on *Advancements and lessons learned during Phase I & II of the DARPA Subterranean Challenge*; Guest editor of the *IEEE Sensors Journal* for the special issue on *Smart Sensing for Agriculture*; Guest editor of the *Autonomous Robots* journal for the special issue on *Online Decision Making in Multi-Robot Coordination*.

Program Committee Member AAMAS 2022, IJCNN 2022, ICRA 2022, SAC 2022, CoDIT 2022, ICARSC 2022, ICARSC 2021, ECMR 2021, IJCNN 2021, AAAI 2020, SAC 2020, ICARSC 2020, IEEE IRC 2020, IJCAI 2020, MESAS 2020, IEEE IRC 2019, IJCNN 2018, AAMAS 2018, AAAI 2018, ACM SAC 2018, ICARSC 2018, MESAS 2018, WCIDM 2018, MRS 2017, ICARSC 2017, IJCAI 2017, IJCNN 2017, SMC 2017, MESAS 2017, WSOM+ 2017, WCIDM 2017, ACM SAC 2016, ICARSC 2016, WCIDM 2016, WSOM 2016, ACM SAC 2015, ICARSC 2015, IJCNN 2015, ITAT 2015, WCIDM 2015, AAAI 2014, SMC 2014, SMC 2013.

Reviewer for Journals Adaptive Behavior; Applied Mathematics and Computation; Applied Soft Computing; Artificial Intelligence Review; Autonomous Robots; Computer Communications; Expert Systems with Applications; Field Robotics; Frontiers in Robotics and AI; IEEE Intelligent Systems; IEEE Transactions on Cybernetics; IEEE Transactions on Neural Networks and Learning Systems; IEEE Transactions on Robotics; International Journal of Advanced Robotic Systems; International Journal of Applied Mathematics and Computer Science; International Journal of Production Research; International Journal of Robotics Research; Journal of Field Robotics; Journal of Intelligent and Robotic Systems; Mechanism and Machine Theory; Neural Networks; Neurocomputing; Neural Computing and Applications; Operational Research Robotics and Autonomous Systems.

Reviewer for Conferences IEEE International Conference on Robotics and Autonomous (ICRA); IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS); Robotics: Science and Systems Conference (RSS).

Ph.D. Theses Reviewer (Committee Member) Matthias Eder: *Improving Robot Navigation in Unstructured Environments Using Traversability Analysis and Explainable Path Planning*, TU Graz, 2024; David Vošahlík: *Advanced Algorithms for Vehicle Dynamics Control*, CTU, FEE, Dept. of Control Engineering, 2024; Jakub Szkandera: *Motion planning for geometric models in data visualization*, University of West Bohemia, 2020; David Woller: *Metaheuristic algorithms for optimization problems sharing permutative representation*, CTU, CIIRC, 2024; Kulatunga Mudiyansele Eranda Tennakoon: *Probe-before-step Gait Framework for Multi-legged Robot Locomotion over Terrains with Risk of Collapse*, Queensland University of Technology, 2020; Lukas Klodt: *Coordination of Cooperative Multi-Robot Teams*, Technische Universität Darmstadt, 2017; Jacopo Banfi: *Multirobot Exploration of Communication-Restricted Environments*, Politecnico di Milano, 2017; Mihai Andries: *Object and human tracking and robot control through a load sensing floor*, Université de Lorraine, 2015.

Supervision of Graduate students

Present 1 Master, and 14 PhD students – Dept. of Computer Science, FEE, CTU.
 2009–2022 4 PhD, 18 Master, and 24 Bachelor students; 7 students received Dean award for their master theses, they finished phd at CTU and University of Birmingham, UK; two student received IT SPY award in 2019 and 2021 for their master theses; 6 students received Dean award for their bachelor theses.

Teaching Activities and Institutional Responsibilities (FEE, CTU)

Lecturer *Artificial Intelligence in Robotics, Procedural Programming, C Programming Language, Programming in C* (2016–present); *Programming 1 and Programming 2* (2014–2015); *Programming Techniques* (2008, 2010); *Programming Methodologies* (2006).
 Instructor *Programming 1 and Programming 2* (2014-2014); *Team Work and its Organization* (2010–2012); *Robots* (2009–2010); *Programming Techniques* (2005–2010); *Programming Methodologies* (2003–2006); *System Reliability and Total Quality Management* (2003–2010).
 2023–present Member of the Scientific Council, Faculty of Electrical Engineering, University of West Bohemia.
 2021–present Member of the Board of doctoral study program Cybernetics and robotics – “Kybernetika a robotika.”
 2019–present Chair of Open Informatics (OI) study bachelor and master study program – “Otevřená informatika”; chair of the Artificial Intelligence specialization.
 2015–2019 Member of the Board of bachelor and master study program – Open Informatics (OI) – “Otevřená informatika”; chair of the Software study branch/specialization.
 2016–present Member of Academic Senate of FEE, CTU.
 2017–present Member of the Board of doctoral study, branch 3708V017 – Air Traffic Control – “Provoz a řízení letecké dopravy.”

Organization of Scientific Meetings

2023 Co-organizer of Workshop on Unconventional Spatial Representations Opportunities for Robotics in conjunction with the IEEE International Conference on Robotics and Automation (ICRA), London, UK.
 2022 Chair of 14th International Workshop on Self-Organizing Maps and Learning Vector Quantization, Clustering and Data Visualization (WSOM+ 2022).
<https://wsom22.fel.cvut.cz>
 2016 Chair of Workshop on On-line decision-making in multi-robot coordination in conjunction with the Robotics: Science and Systems Conference (RSS 2016), Ann Arbor, Michigan, USA.
<http://robotics.fel.cvut.cz/demur16>
 2015 Chair of Workshop on On-line decision-making in multi-robot coordination in conjunction with IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Germany.
<http://robotics.fel.cvut.cz/demur15>
 2014–2022 Chair of Student Conference on Planning in Artificial Intelligence and Robotics (PAIR).
<http://robotics.fel.cvut.cz/pair>
 2014 Chair of Workshop on Multi-Agent Coordination in Robotic Exploration in conjunction of ECAI 2014, Czech Republic. <http://robotics.fel.cvut.cz/macorex14>

List of the Main Publications for the Last Five Years

- [1] Jindřiška Deckerová, Petr Váňa, and Jan Faigl. Combinatorial lower bounds for the generalized traveling salesman problem with neighborhoods. *Expert Systems with Applications*, 258(15):125185, 2024.
- [2] Ping Zhou, Xuewu Dai, Kyriakos G. Vamvoudakis, Jan Faigl, and Hong Wang. Guest editorial special issue on learning from imperfect data for industrial automation. *IEEE Transactions on Automation Science and Engineering*, 21(2):1088–1091, 2024.
- [3] David Valouch and Jan Faigl. Caterpillar heuristic for gait-free planning with multi-legged robot. *IEEE Robotics and Automation Letters*, 8(8):5204–5211, 2023.
- [4] František Nekovář, Jan Faigl, and Martin Saska. Multi-vehicle dynamic water surface monitoring. *IEEE Robotics and Automation Letters*, 2023.
- [5] Jan Bayer, Petr Čížek, and Jan Faigl. Autonomous multi-robot exploration with ground vehicles in darpa subterranean challenge finals. *Field Robotics*, 3:266–300, 2023.
- [6] Hari Prabhat Gupta, Uttam Ghosh, Biplab Sikdar, Tanima Dutta, Jan Faigl, Venkat R. Bhethanabotla, and Kunal Mondal. Guest editorial special issue on the role of smart sensing for communicable diseases (including covid-19). *IEEE Sensors Journal*, 23(2):864–864, 2023.
- [7] Miloš Prágr, Jan Bayer, and Jan Faigl. Autonomous exploration with online learning of traversable yet visually rigid obstacles. *Autonomous Robots*, 47:161–180, 2023.
- [8] Jan Drchal, Jan Faigl, and Petr Váňa. Wism: Windowing surrogate model for evaluation of curvature-constrained tours with dubins vehicle. *IEEE Transactions on Cybernetics*, 52(2):1302–1311, 2022.
- [9] Doron Pinsky, Petr Váňa, Jan Faigl, and Oren Salzman. $T^*\epsilon$ —bounded-suboptimal efficient motion planning for minimum-time planar curvature-constrained systems. *IEEE Robotics and Automation Letters*, 7(2):4102–4109, 2022.
- [10] Jindřiška Deckerová, Jan Faigl, and Vít Krátký. Traveling salesman problem with neighborhoods on a sphere in reflectance transformation imaging scenarios. *Expert Systems with Applications*, 198:116814, 2022.
- [11] Miloš Prágr, Jan Bayer, and Jan Faigl. Autonomous robotic exploration with simultaneous environment and traversability models learning. *Frontiers in Robotics and AI*, 9, 2022.
- [12] Rudolf Szadkowski, Jan Drchal, and Jan Faigl. Continually trained life-long classification. *Neural Computing and Applications*, 34:135–152, 2022.
- [13] František Nekovář, Jan Faigl, and Martin Saska. Multi-tour set traveling salesman problem in planning power transmission line inspection. *IEEE Robotics and Automation Letters*, 6(4):6196–6203, 2021.
- [14] Rudolf Szadkowski, Miloš Prágr, and Jan Faigl. Self-learning event mistiming detector based on central pattern generator. *Frontiers in Neurobotics*, 15:5, 2021.
- [15] Petr Čížek, Martin Zoula, and Jan Faigl. Design, construction, and rough-terrain locomotion control of novel hexapod walking robot with four degrees of freedom per leg. *IEEE Access*, 9:17866–17881, 2021.
- [16] Hari Prabhat Gupta, Houbing Song, Biplab Sikdar, Tanima Dutta, and Jan Faigl. Guest editorial special issue on smart sensing for agriculture. *IEEE Sensors Journal*, 21(16):17419–17419, 2021.
- [17] Jan Faigl. Unsupervised learning-based solution of the close enough dubins orienteering problem. *Neural Computing and Applications*, 24(32):18193–18211, 2020.
- [18] Petr Váňa, Jakub Sláma, and Jan Faigl. Surveillance planning with safe emergency landing guarantee for fixed-wing aircraft. *Robotics and Autonomous Systems*, 133:103644, 2020.
- [19] Petr Váňa and Jan Faigl. Optimal solution of the generalized dubins interval problem finding the shortest curvature-constrained path through a set of regions. *Autonomous Robots*, 44(7):1359–1376, 2020.
- [20] Martin Zoula and Jan Faigl. Wireless communication infrastructure building for mobile robot search and inspection missions. In *IEEE Int. Conf. Robotics and Automation (ICRA)*, pages 5970–5976, 2024.
- [21] Miloš Prágr, Jan Bayer, and Jan Faigl. On predicting terrain changes induced by mobile robot traversal. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 11693–11698, 2024.
- [22] Jan Bayer and Jan Faigl. Reward-field guided motion planner for navigation with limited sensing range. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 3167–3174, 2024.
- [23] Vsevolod Hulchuk, Jan Bayer, and Jan Faigl. Lidar-visual-inertial tightly-coupled odometry with adaptive learnable fusion weights. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 5641–5647, 2024.

- [24] Jakub Sláma, Jáchym Herynek, and Jan Faigl. Risk-aware emergency landing planning for gliding aircraft model in urban environments. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, 2023.
- [25] Rudolf Szadkowski, Muhammad Sunny Nazeer, Matteo Cianchetti, Egidio Falotico, and Jan Faigl. Bootstrapping the dynamic gait controller of the soft robot arm. In *IEEE Int. Conf. Robotics and Automation (ICRA)*, pages 2669–2675, 2023.
- [26] David Valouch and Jan Faigl. Motion planning for multi-legged robots using levenberg-marquardt optimization with bézier parametrization. In *European Conference on Mobile Robots (ECMR)*, 2023.
- [27] Jindřiška Deckerová, Kristýna Kučerová, and Jan Faigl. On improvement heuristic to solutions of the close enough traveling salesman problem in environments with obstacles. In *European Conference on Mobile Robots (ECMR)*, 2023.
- [28] Vsevolod Hulchuk, Jan Bayer, and Jan Faigl. Graph-based lidar-inertial slam enhanced by loosely-coupled visual odometry. In *European Conference on Mobile Robots (ECMR)*, 2023.
- [29] Petr Váňa and Jan Faigl. Bounding optimal headings in the dubins touring problem. In *37th Annual ACM Symposium on Applied Computing*, pages 770–773, 2022.
- [30] Josef Zelinka, Miloš Prágr, Rudolf Szadkowski, Jan Bayer, and Jan Faigl. Traversability transfer learning between robots with different cost assessment policies. In *2021 Modelling and Simulation for Autonomous Systems (MESAS)*, volume 13207, pages 333–344, 2022.
- [31] Miloš Prágr, Rudolf Szadkowski, Jan Bayer, Josef Zelinka, and Jan Faigl. Terrain traversal cost learning with knowledge transfer between multi-legged walking robot gaits. In *2022 IEEE International Conference on Autonomous Robot Systems and Competitions (ICARSC)*, pages 148–153, 2022.
- [32] Jakub Sláma, Petr Váňa, and Jan Faigl. Generating safe corridors roadmap for urban air mobility. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 11866–11871, 2022.
- [33] Jan Feber, Rudolf Szadkowski, and Jan Faigl. Gait adaptation after leg amputation of hexapod walking robot without sensory feedback. In *International Conference on Artificial Neural Networks (ICANN)*, pages 656–667, 2022.
- [34] Jáchym Herynek, Petr Váňa, and Jan Faigl. Finding 3d dubins paths with pitch angle constraint using non-linear optimization. In *European Conference on Mobile Robots (ECMR)*, pages 1–6, 2021.
- [35] Kristýna Kučerová, Petr Váňa, and Jan Faigl. Variable-speed traveling salesman problem for vehicles with curvature constrained trajectories. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 4714–4719, 2021.
- [36] Jan Sláma, Petr Váňa, and Jan Faigl. Risk-aware trajectory planning in urban environments with safe emergency landing guarantee. In *IEEE International Conference on Automation Science and Engineering (CASE)*, pages 1606–1612, 2021.
- [37] Jan Bayer and Jan Faigl. Decentralized topological mapping for multi-robot autonomous exploration under low-bandwidth communication. In *European Conference on Mobile Robots (ECMR)*, pages 1–7, 2021.
- [38] David Valouch and Jan Faigl. Gait-free planning for hexapod walking robot. In *European Conference on Mobile Robots (ECMR)*, pages 1–8, 2021.
- [39] Martin Zoula, Miloš Prágr, and Jan Faigl. On building communication maps in subterranean environments. In *2020 Modelling and Simulation for Autonomous Systems (MESAS)*, pages 15–28, 2021.
- [40] Jiří Kubík, Petr Čížek, Rudolf Szadkowski, and Jan Faigl. Experimental leg inverse dynamics learning of multi-legged walking robot. In *2020 Modelling and Simulation for Autonomous Systems (MESAS)*, pages 154–168, 2021.
- [41] Jan Bayer and Jan Faigl. Vision-based localization for multi-rotor aerial vehicle in outdoor scenarios. In *2020 Modelling and Simulation for Autonomous Systems (MESAS)*, pages 217–228, 2021.
- [42] Tomáš Vintr, Zhi Yan, Kerem Eyisoy, Filip Kubiš, Jan Blaha, Jiří Ulrich, Chittaranjan S. Swaminathan, Sergi Molina, Tomasz P. Kucner, Martin Magnusson, Gregorz Cielniak, Jan Faigl, Tom Duckett, Achim J. Lilienthal, and Tomáš Krajník. Natural criteria for comparison of pedestrian flow forecasting models. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 11197–11204, 2020.
- [43] Jan Faigl, Petr Váňa, and Jan Drchal. Fast sequence rejection for multi-goal planning with dubins vehicle. In *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pages 6773–6780, 2020.
- [44] Petr Váňa, Armando Alves Neto, Jan Faigl, and Douglas G. Macharet. Minimal 3d dubins path with bounded curvature and pitch angle. In *IEEE Int. Conf. Robotics and Automation (ICRA)*, pages 8497–8503, 2020.
- [45] Rudolf Szadkowski and Jan Faigl. Neurodynamic sensory-motor phase binding for multi-legged walking robots. In *International Joint Conference on Neural Networks (IJCNN)*, pages 1–8, 2020.