Mgr. Michal Vavrečka, Ph.D.

Developmental Robotics Researcher

Czech Institute of Informatics, Robotics and Cybernetics (CIIRC), CTU in Prague
Jugoslávských partyzánů 1580/3, 160 00 Prague 6
michal.vavrecka@cvut.cz | +420 608 661 977
michalvavrecka.github.io | GitHub | LinkedIn

PERSONAL PROFILE

I am a cognitive scientist specializing in developmental robotics, artificial intelligence, and cognitive modeling. Since the beginning of my research in 2005, I have been dedicated to the principles of Artificial General Intelligence (AGI). During my psychology studies, I was already creating my own cognitive architectures. I continue this work by testing cognitive architectures in humanoid robots, which I train according to the principles of developmental robotics using reinforcement learning and intrinsic motivation, utilizing advanced robotic simulators that enable the automated creation of long task sequences (lifelong learning). In my research, I connect findings from psychology and neuroscience with technical applications in robotics.

EDUCATION

2005 – 2008 **Ph.D., General Psychology**
Masaryk University, Faculty of Social Studies, Brno
Dissertation Thesis: Application of cognitive semantics in the model of spatial relations representation.

1999 – 2005 **Mgr. (M.A.), Psychology**
Masaryk University, Faculty of Arts, Brno
Master's Thesis: Methods of Human Intelligence Simulation.

EXPERIENCE

04/2017 – present **Researcher**
Czech Technical University in Prague, Czech Institute of Informatics, Robotics and Cybernetics
Development of algorithms for humanoid robots and research in human-robot interaction.

10/2022 – 10/2025 **Researcher**
Comenius University Bratislava, Faculty of Mathematics, Physics and Informatics
Development of algorithms for humanoid robots.

01/2019 – 12/2021 **Researcher**
Academy of Sciences of the Czech Republic, Institute of Physiology
Development of algorithms for advanced EEG signal processing and research in spatial cognition.

04/2016 – 12/2018 **Researcher**
Academy of Sciences of the Czech Republic, Institute of Computer Science
Development of algorithms for advanced EEG signal processing and research in neuroscience.

07/2014 – 12/2015 **Researcher**
National Institute of Mental Health, Klecany
Development of algorithms for advanced EEG signal processing and research in neuropsychology.

12/2012 – 06/2015 **Postdoc**
University of South Bohemia in České Budějovice, Faculty of Education
Neuropsychological research in the field of emotions and EEG signal processing.

04/2008 – 12/2016 **Assistant Professor**
Czech Technical University in Prague, Faculty of Electrical Engineering
Research in spatial cognition, development of algorithms for EEG processing.

FOUNDED LABORATORIES

2014 **Incognite lab**
The laboratory focuses on research in developmental robotics. It develops software for training humanoid robots, such as myGym and PRAG.

2012 **Neuropsychological Lab at USB**
Open access laboratory equipped with 64-channel EEG and eye-tracker. The laboratory serves for administering experiments in cognitive and affective neuroscience.

2009 **EEG Neuropsychological Lab at FEE CTU**
Laboratory designed for experiments focused primarily on spatial cognition.

PROJECTS AND GRANTS

2023-2025 **iChores**
Creation of an architecture for a humanoid robot enabling control via language instructions and gestures.

2022-2025 **TERAIS**
Project focused on twinning cooperation with the University of Hamburg and IIT Genoa in the field of cognitive robotics.

2021-2024 **MIRRACLE**
Research on multimodal representations of robotic actions and tasks applied to imitation learning.

2019-2021 **HUMR**
Using the humanoid robot Pepper for activation and cognitive training of seniors.

2019-2021 **Tradr**
Rescue robot for deployment in difficult conditions.

2012-2015 **CloPeMa**
Clothes recognition and folding using a dual-arm robot.

2011-2013 **EEGin3Dspace**
Spatial reference frames in a 3D environment and their EEG analysis.

SOFTWARE

- **PRAG:** Procedural task generator for robotic tasks with automatic training.
- **myGym:** Robotic simulator for training tasks using multi-policy algorithms.
- **iChores:** Controlling the Tiago humanoid robot using language and gestures.
- **NicoIK:** Inverse kinematics and automatic grasping for the Nico humanoid robot.
- **Pepper Controller:** Controlling the Pepper humanoid robot from a Python environment.
- **Bioloid Toolbox:** Controlling the Bioloid humanoid robot.
- **EEG Neurofeedback:** Software for neurofeedback using EEG.
- **VR Bone Assembly 2.0:** Educational software for medical students.

RESEARCH STAYS

- **2017** Tokyo University of Agriculture and Technology, Japan
- **2014:** Technical University of Berlin, Department of Biopsychology, Germany
- **2009:** Comenius University Bratislava, Faculty of Mathematics, Physics and Informatics, Slovakia
- **2006:** Comenius University Bratislava, Faculty of Mathematics, Physics and Informatics, Slovakia

LIST OF PUBLICATIONS

Journal Articles

1. Farkaš, I., **Vavrečka, M.**, & Wermter, S. (2025). Will multimodal large language models ever achieve deep understanding of the world? *Frontiers in Systems Neuroscience*, 19, 1683133.
2. Štěpánová, K., Klein, F. B., Cangelosi, A., & **Vavrečka, M.** (2018). Mapping language to vision in a real-world robotic scenario. *IEEE Transactions on Cognitive and Developmental Systems*, 10(3), 784-794.
3. Hoffmann, M., Straka, Z., Farkas, I., **Vavrecka, M.** & Metta, G. (2017). Robotic homunculus: Learning of artificial skin representation in a humanoid robot motivated by primary somatosensory cortex. *IEEE Transactions on Cognitive and Developmental Systems*.
4. Plassová, M., Stuchlíková, I., **Vavrečka, M.** (2017). Úvod do aproximálního numerického systému. *Pedagogika*, 67 (2).
5. Štěpánová K., **Vavrečka M.** (2016). Estimating number of components in Gaussian mixture model using combination of greedy and merging algorithm. *Pattern Analysis and Applications*.
6. Fiedler, J., Mrhálek, T., **Vavrečka, M.**, et al. (2016). Kognice a hemodynamika po karotické endarterektomii pro asymptomatickou stenózu. *Česká a slovenská neurologie a neurochirurgie*, 79/112(2), 201–206.
7. Fiedler, J., ... **Vavrečka, M.**, et al. (2015). Cognitive Outcome and Hemodynamic Changes 3 months after Carotid Endarterectomy. *Journal of Neurosurgery*, 123(2).
8. **Vavrečka, M.**, & Farkaš, I. (2014). A multimodal connectionist architecture for unsupervised grounding of spatial language. *Cognitive Computation*, 6(1), 101-112.
9. **Vavrečka, M.**, Gerla, V., Lhotská, L., & Brunovský, M. (2012). Frames of reference and their neural correlates within navigation in a 3D environment. *Visual Neuroscience*, 29(03), 183-191.
10. **Vavrečka, M.**, & Lhotská, L. (2012). Odlišnosti užívání referenčních rámců během orientace v 3D prostoru. *Linguistica ONLINE*, 14, 95-100.
11. **Vavrečka, M.**, & Lhotská, L. (2012). The alteration of reference frames in a vertical navigation. *Cognitive Processing*, Springer Berlin.
12. **Vavrečka, M.**, Rosset, B., & Lhotská, L. (2012). The inter-individual differences and the test–retest reliability of a EEG signal. *Clinical Neurophysiology*, 123(3).
13. **Vavrečka, M.**, & Lhotská, L. (2011). Event related spectral perturbations within 3D navigation task. *Activitas Nervosa Superior Rediviva*, 53.
14. **Vavrečka, M.** (2009). The neural correlates of spatial reference frames processing. *Cognitive Processing*, 10:2, 342-345.

Conference Papers

1. Zamrazilova, K., **Vavrecka, M.**, Ostapenko, S., Sejnova, G., & Skovierova, J. (2025). "Are Multimodal Signals Synchronous?": Temporal Relation of Declarative Gestures and Language Instructions in Human Robot Interaction. *2025 IEEE International Conference on Development and Learning (ICDL)*, 1-6.
2. Škoviera, R., **Vavrečka, M.**, Šejnová, G., & Štěpánová, K. (2025). PRAG: Procedural Action Sequence Symbolic Generator as a Mechanism for Autonomous Learning. *2025 IEEE International Conference on Development and Learning (ICDL)*, 1-8.

3. Gavura, J., **Vavrečka, M.**, Farkaš, I., & Gäde, C. (2025). Robotic Calibration Based on Haptic Feedback Improves Sim-to-Real Transfer. *International Conference on Artificial Neural Networks (ICANN)*, 136-148.

4. Lúčny, A., Antonj, M., Mazzola, C., ... & **Vavrečka, M.** (2025). Examining the legibility of humanoid robot arm movements in a pointing task. *arXiv preprint arXiv:2508.05104*.

5. **Vavrecka, M.**, Skoviera, R., Sejnova, G., & Stepanova, K. (2025). PRAG: Procedural Action Generator. *arXiv preprint arXiv:2507.09167*.

6. Sejnova, G., **Vavrecka, M.**, & Stepanova, K. (2024). Bridging language, vision and action: Multimodal VAEs in robotic manipulation tasks. *2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*.

7. **Vavrecka, M.**, Kriz, J., Sokovnin, N., & Sejnova, G. (2024). Modular Reinforcement Learning In Long-Horizon Manipulation Tasks. *International Conference on Artificial Neural Networks (ICANN)*, 299-312.

8. Ostapenko, A., & **Vavrecka, M.** (2024). Action Recognition System Integrating Motion and Object Detection. *International Conference on Artificial Neural Networks (ICANN)*, 259-269.

9. Sejnova, G., **Vavrecka, M.**, & Stepanova, K. (2024). Adaptive compression of the latent space in variational autoencoders. *International Conference on Artificial Neural Networks (ICANN)*, 89-101.

10. Sienkiewicz, B., Sejnova, G., Gajewski, P., **Vavrecka, M.**, & Indurkhya, B. (2023). Native Czech speakers consider English-speaking robots more intelligent. *Proceedings of the 11th International Conference on Human-Agent Interaction (HAI)*, 362-364.

11. Sienkiewicz, B., Sejnova, G., Gajewski, P., **Vavrecka, M.**, & Indurkhya, B. (2023). How language of interaction affects the user perception of a robot. *International Conference on Social Robotics (ICSR)*, 308-321.

12. **Vavrecka, M.**, Sejnova, G., & Schimperk, P. (2022). Personified Robotic Chatbot Based On Compositional Dialogues. *International Conference on Interactive Media, Smart Systems and Emerging Technologies (IMET)*, 1-2.

13. **Vavrecka, M.**, Sokovnin, N., Mejdrechova, M., & Sejnova, G. (2021). myGym: Modular toolkit for visuomotor robotic tasks. *2021 IEEE 33rd International Conference on Tools with Artificial Intelligence (ICTAI)*, 279-283.

14. Sejnova, G., Mejdrechova, M., ... & **Vavrecka, M.** (2021). Reward Redistribution for Reinforcement Learning of Dynamic Nonprehensile Manipulation. *2021 7th International Conference on Control, Automation and Robotics (ICCAR)*, 326-331.

15. Niyogi, R., Sharma, S., **Vavrecka, M.**, & Milani, A. (2020). A Learning Based Approach for Planning with Safe Actions. *Computational Science and Its Applications – ICCSA 2020*, 93-105.

16. Sejnova, G., **Vavrecka, M.**, Tesar, M., & Skoviera, R. (2019). Exploring logical consistency and viewport sensitivity in compositional VQA models. *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2108-2113.

17. Sejnova, G., Tesar, M., & **Vavrecka, M.** (2018). Compositional models for VQA: Can neural module networks really count? *Procedia computer science*, 145, 481-487.

18. Plassová, M., Tesař, M., **Vavrečka, M.**, & Valuchová, K. (2016). Approximate number system in children. *Proceedings of the 6th Biannual CER Comparative European Research Conference*, 182-187.

19. **Vavrečka, M.**, Kužílek, J., & Lhotská, L. (2013). Vliv kontextu na orientaci v prostoru. *Kognícia a umely život XIII*, 279-285.

20. **Vavrečka, M.**, & Lhotská, L. (2013). EEG Feature Selection Based on Time Series Classification. *Lecture Notes in Computer Science (LNCS)*, vol. 7988, 520-527.

21. **Vavrečka, M.**, & Farkaš, I. (2012). Unsupervised Visual and Lexical Binding. *Proceedings of International Conference on Cognitive Systems*.

22. **Vavrečka, M.**, Farkaš, I., & Lhotská, L. (2011). Bio-inspired Model of Spatial Cognition. *Lecture Notes in Computer Science 7062 (LNCS)*, 443-450.

23. **Vavrečka, M.**, & Lhotská, L. (2011). EEG analysis of the navigation strategies in a 3D tunnel task. *Lecture Notes in Computer Science 7062 (LNCS)*, 388-395.

24. **Vavrečka, M.** (2011). Visually driven homonyms disambiguation. *Kognice a umělý život XI*, 293-299.

25. **Vavrečka, M.**, & Farkaš, I. (2011). Unsupervised Grounding of Spatial Relations. *Proceedings of the Third European Conference on Cognitive Science*, Bulgaria.

26. **Vavrečka, M.**, & Farkaš, I. (2010). Unsupervised model for grounding multimodal representations. *Third EuCogII Members Conference*, Mallorca.

27. **Vavrečka, M.**, Kužílek J., & Lhotská, L. (2010). Classification of the EEG feature components. *10th International Conference on Information Technology and Applications in Biomedicine.*

28. **Vavrečka, M.** (2010). Representation of objects in space based on two visual pathways. *Kognice a umělý život X*, 403-409.

29. Macaš, M., **Vavrečka, M.**, Gerla V., & Lhotská, L. (2009). Classification of the emotional states based on the EEG signal processing. *9th International Conference on Information Technology and Applications in Biomedicine.*

30. **Vavrečka, M.** (2009). The EEG Correlates of the Allocentric and the Egocentric Spatial Reference Frames Processing. *World Congress on Medical Physics and Biomedical Engineering*, 2295-2299.

31. **Vavrečka, M.** (2009). The EEG activity within the spatial navigation. *Kognice a umělý život IX*, 341-350.

32. **Vavrečka, M.** (2008). Spatial frames of reference processing and its EEG correlates. *55. společný sjezd české a slovenské společnosti klinické neurofyziologie.*

33. **Vavrečka, M.** (2008). Multimodal representations for symbol grounding. *Kognice a umělý život VIII.*

34. **Vavrečka, M.** (2007). Grounding of spatial terms. *Kognice a umělý život VII*, 365-377.

35. **Vavrečka, M.** (2006). Symbol grounding in context of zero semantic commitment. *Kognice a umělý život VI*, 401-411.

36. **Vavrečka, M.** (2006). How long-term presentation of text stimuli affects production and perception of visual mental images. *Kognice 2006*, 150-158.