

I. Personal and study details

Student's name: **Tsoy Artyom**

Personal ID number: **504451**

Faculty / Institute: **Faculty of Electrical Engineering**

Department / Institute: **Department of Cybernetics**

Study program: **Cybernetics and Robotics**

II. Bachelor's thesis details

Bachelor's thesis title in English:

Improving Path Planning Methods Using Machine Learning

Bachelor's thesis title in Czech:

Využití strojového učení v úloze plánování pohybu

Guidelines:

1. Study path planning problem [1] and get familiar with sampling-based path planning methods (e.g., RRT and RRT*) [1,2,3]. Implement basic RRT and RRT* in C/C++ or Python. Get familiar with neural networks [6].
2. Implement a machine-learning method for estimating suitable sampling regions for RRT-based planners (use e.g. [4,7]). The method should predict where to draw random samples based on the state of the environment and goal. Implement the method for 2D configuration space.
3. Extend the method from task 2) to 3D and 6D configuration space.
4. Compare all implemented methods from tasks 2) and 3) with related work using the OMPL library [5].

Bibliography / sources:

- [1] LaValle, Steven M. Planning Algorithms. 1st ed. Cambridge University Press, 2006.
<https://doi.org/10.1017/CBO9780511546877>.
- [2] LaValle, Steven. "Rapidly-exploring random trees: A new tool for path planning." Research Report 9811 (1998).
- [3] Karaman, S., & Frazzoli, E. (2011). Sampling-based algorithms for optimal motion planning. The international journal of robotics research, 30(7), 846-894.
- [4] O. Arslan and P. Tsiotras, "Machine learning guided exploration for sampling-based motion planning algorithms," 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Hamburg, Germany, 2015, pp. 2646-2652, doi: 10.1109/IROS.2015.7353738.
- [5] Mark Moll, Ioan A. Băcută, Lydia E. Kavraki, Benchmarking Motion Planning Algorithms: An Extensible Infrastructure for Analysis and Visualization, IEEE Robotics & Automation Magazine, 22(3):96–102, September 2015.
- [6] Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
- [7] A. H. Qureshi, Y. Miao, A. Simeonov and M. C. Yip, "Motion Planning Networks: Bridging the Gap Between Learning-Based and Classical Motion Planners," in IEEE Transactions on Robotics, vol. 37, no. 1, pp. 48-66, Feb. 2021, doi: 10.1109/TRO.2020.3006716.

Name and workplace of bachelor's thesis supervisor:

Ing. Vojtěch Vonásek, Ph.D. Multi-robot Systems FEE

Name and workplace of second bachelor's thesis supervisor or consultant:

Date of bachelor's thesis assignment: **23.01.2024** Deadline for bachelor thesis submission: _____

Assignment valid until: **21.09.2025**

Ing. Vojtěch Vonásek, Ph.D.
Supervisor's signature

prof. Dr. Ing. Jan Kybic
Head of department's signature

prof. Mgr. Petr Páta, Ph.D.
Dean's signature

III. Assignment receipt

The student acknowledges that the bachelor's thesis is an individual work. The student must produce his thesis without the assistance of others, with the exception of provided consultations. Within the bachelor's thesis, the author must state the names of consultants and include a list of references.

Date of assignment receipt

Student's signature