Heuristics and Optimization based for Path/Motion Planning Problems

Assignment Topics HK251

Below are some typical case studies for your choice, but not limited.

Shortest Path and Motion planning

A survey for the heuristic based robot path planning: *Mac et al., Heuristic approaches in robot path planning: A survey, Robotics and Autonomous Systems, pp. 13-28, 2016.* (pdf in LMS)

(1) Multi-strategy fusion methods
   - **References:**
     - https://www.nature.com/articles/s41598-025-92675-5
     - https://www.nature.com/articles/s41598-025-13915-2

(2) Bi-directional sampling based for path planning in dynamic environments
   - **References:**
     - https://arxiv.org/pdf/2301.11816, https://arxiv.org/abs/2010.14693
     - Fu et al., Adaptive Goal-Biased Bi-RRT for Online Path Planning of Robotic Manipulators, ICIRA 2023. (pdf in LMS)

(3) Optimization based
   - **References:** https://www.science.org/doi/10.1126/scirobotics.adf7843

(4) ACO based method:
   - **References**: https://www.nature.com/articles/s41598-025-93571-8

Complete Coverage Path Planning

A comprehensive survey: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9523743

(5) C* Algorithm
   - **References:** https://arxiv.org/abs/2505.13782

(6) BA* and B-Theta*
   - **References**:
     - BA*: https://link.springer.com/article/10.1007/s10489-012-0406-4 (pdf in LMS)
     - B-Theta*: https://link.springer.com/article/10.1007/s10846-017-0485-x (pdf in LMS)

(7) ACO based method:
   - **References:** https://doi.org/10.1016/j.compag.2014.08.013 (pdf in LMS)

Evaluation

- Student teams will submit all materials of the assignment to LMS.
- Full report will also be examined.

Reports and presentation

- ***Starting week: 43 (Learning week: 9)***

- Reports
    - A full (text) report should include:
        - Introduction (*Problem statement, Applications, How the problem has been solving together with their pros and cons, why we use this our method.*)
        - Methods/Approaches (*Overview description, architecture/method pipeline, main steps*.)
        - Experiments (*Implementation description, testing for benchmark datasets, experimental results, evaluation*)
        - Improvement or application proposal (***Optional and bonus.***)
        - References.
    - Presentation slides. (***optional but encouraged***)
    - Source codes.
- Report submission: **Team leader should upload to LMS.**
- Deadline for report submission: **The date of the final exam.**