

Pathfinding and Routing

NAIL137

Demos and Open problems

Jiří Švancara



FACULTY
OF MATHEMATICS
AND PHYSICS
Charles University

Community - IRL meetings

- International Symposium on Combinatorial Search (SoCS)
- International Workshop on Multi-Agent Path Finding
- European Workshop on Multi-Agent Pathfinding

Community - Webpages

- <https://mapf.info/>
- <https://movingai.com/benchmarks/mapf/index.html>
- <https://tracker.pathfinding.ai/>

Research groups

- Ben Gurion, Bar-Ilan (Israel)
 - Ariel Felner, Roni Stern, Dor Atzmon, Eli Boyarski
- Monash (Australia)
 - Daniel Harabor, Peter Stuckey, Edward Lam
- Carnegie Mellon (USA)
 - Jiaoyang Li
- University of Alberta (Canada)
 - Nathan Sturtevant
- University of California (USA)
 - Sven Koenig, Satish Kumar, Wolfgang Hoenig
- Cambridge (UK)
 - Keisuke Okumura
- Charles, CTU (CZ)
 - Roman Barták, Jiří Švancara, Pavel Surýnek
- ...

Important papers

- Multi-Agent Pathfinding: Definitions, Variants, and Benchmarks
- Scalable Rail Planning and Replanning: Winning the 2020 Flatland Challenge
- Scaling Lifelong Multi-Agent Path Finding to More Realistic Settings: Research Challenges and Opportunities
- A Comprehensive Review on Leveraging Machine Learning for Multi-Agent Path Finding
- 42+ Flavors of Multi-Agent Path Finding

Code repos

- <https://github.com/Jiaoyang-Li/CBSH2-RTC>
- <https://github.com/svancaj/MAPF-encodings>
- <https://github.com/Jiaoyang-Li/MAPF-LNS2>
- <https://github.com/kei18/lacam0>
- <https://github.com/kei18/lacam3>
- <https://github.com/Kei18/mapf-visualizer>

Interesting videos and online readings

- **Pathfinding in StarCraf 1**
<https://www.codeofhonor.com/blog/the-starcraft-path-finding-hack/>
- **Keisuke Okumura**
<https://www.youtube.com/watch?v=XeZTyUS8ZF0>
- **League of Robot Runners**
https://www.youtube.com/watch?v=Y-v3h_27PXk
- **2021 Flatland Challenge**
<https://www.youtube.com/watch?v=baRffuFM7IE>
- **Interview with Tiberian Sun developer**
<https://www.youtube.com/watch?v=S-VAL7Epn3o>
- **Levels of vehicle autonomy**
<https://www.autoevolution.com/news/the-six-levels-of-vehicle-autonomy-and-what-each-of-them-means-253964.html#>
- **VRP via CSP talk**
https://www.youtube.com/watch?v=BZA_UaX8rs8

Open problems

- In general
 - Better scaling
 - Better plan quality
 - Add new constraints
 - Execution on physical agents

Open problems at CUNI

- Improve SAT models

Open problems at CUNI

- MAPF-LNS with different definition of neighborhood
 - Neighborhood is a location in a map
 - Use reduction-based solvers to repair
 - Retime rest of the plans
 - Crucial is selecting the location!

Open problems at CUNI

- Single agent pathplanning, repairs using SAT

Open problems at CUNI

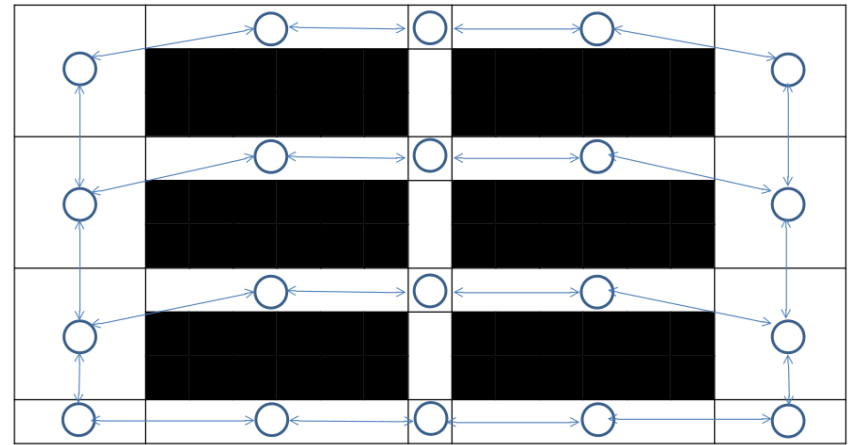
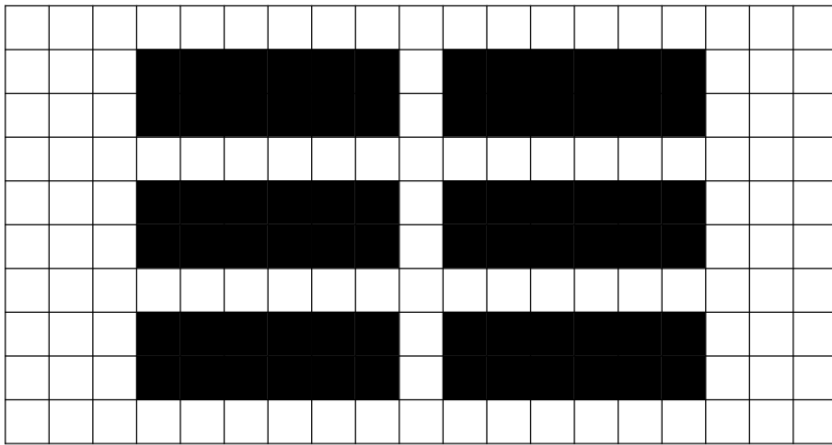
- Waypoint-based system for lifelong MAPF
 - Use RHCR framework
 - Instead of calculating rest of the plan (A* ignoring conflicts), navigate towards waypoint

Open problems at CUNI

- Many approaches from VRP were adapted to MAPF years later
- Evolutionary algorithms were not used
- How to encode and mutate?

Open problems at CUNI

- Decompose the problem
 - Top level is smart
 - Low level is rule-based



Open problems at CUNI

- Decompose the problem
 - Some parts of the problem are known to be easy (solved optimally in P)
 - Some parts are known to be hard
 - Separate them, use different solver for both

Open problems at CUNI

- Special use-case
 - UK, small modular reactors
 - Construction hall uses overhead crane system
 - MAPF + some agents transform the map (rail system)

Open problems at CUNI

- Storage of goods in warehouse to improve throughput
- Change layout of the warehouse to improve throughput