

Efficient Sampling-based Approaches to Optimal Path Planning in Complex Cost Spaces

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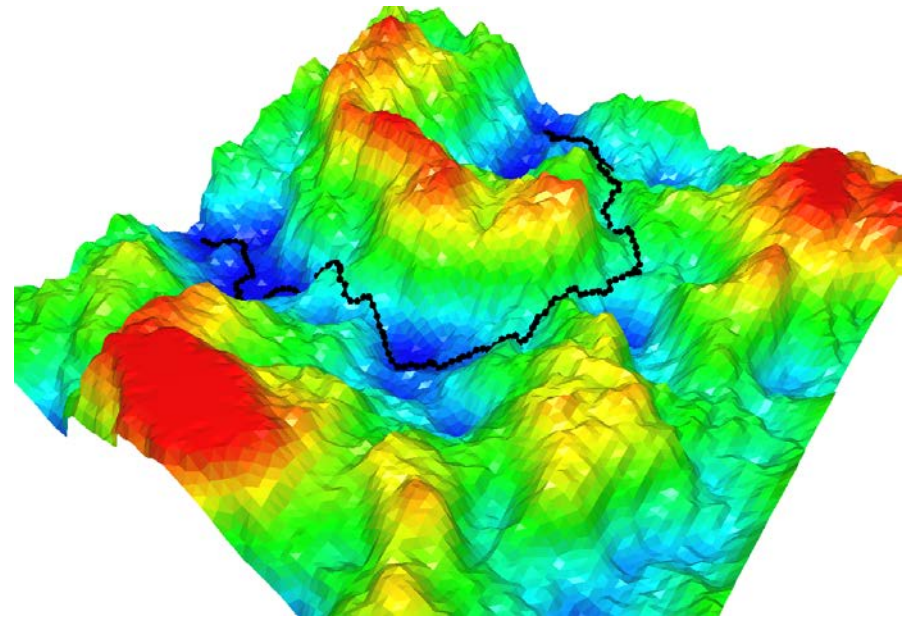
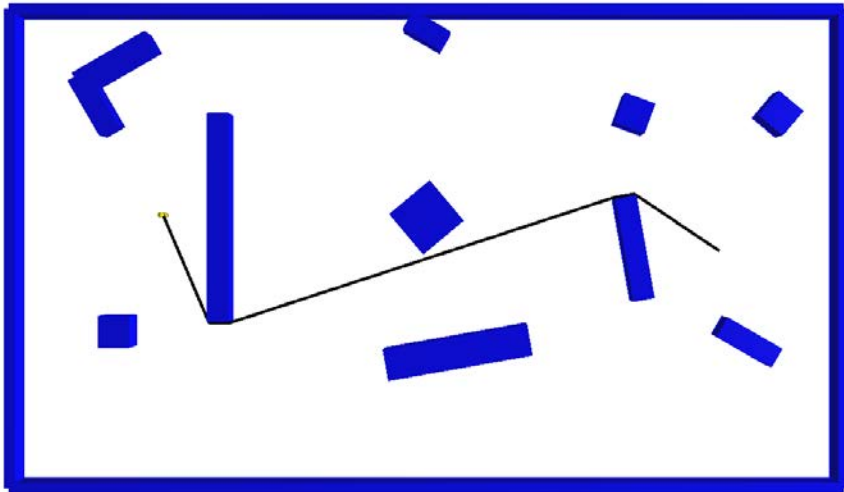


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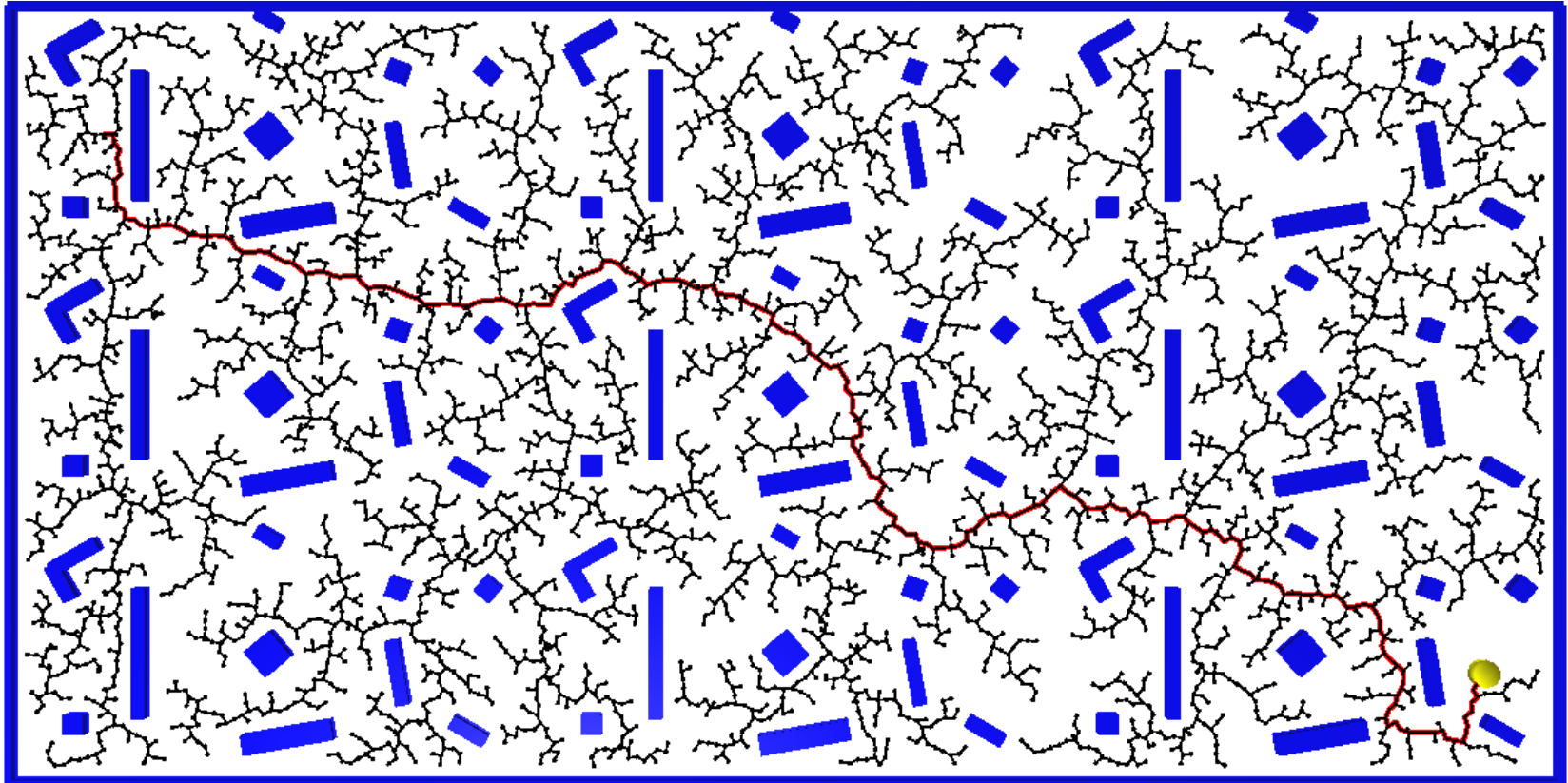
Feasible vs. cost-space path planning

- Feasible path planning **vs.**
 - configuration space
 - collision-free paths
- Cost-space path planning
 - C-space with cost function
 - high-quality paths



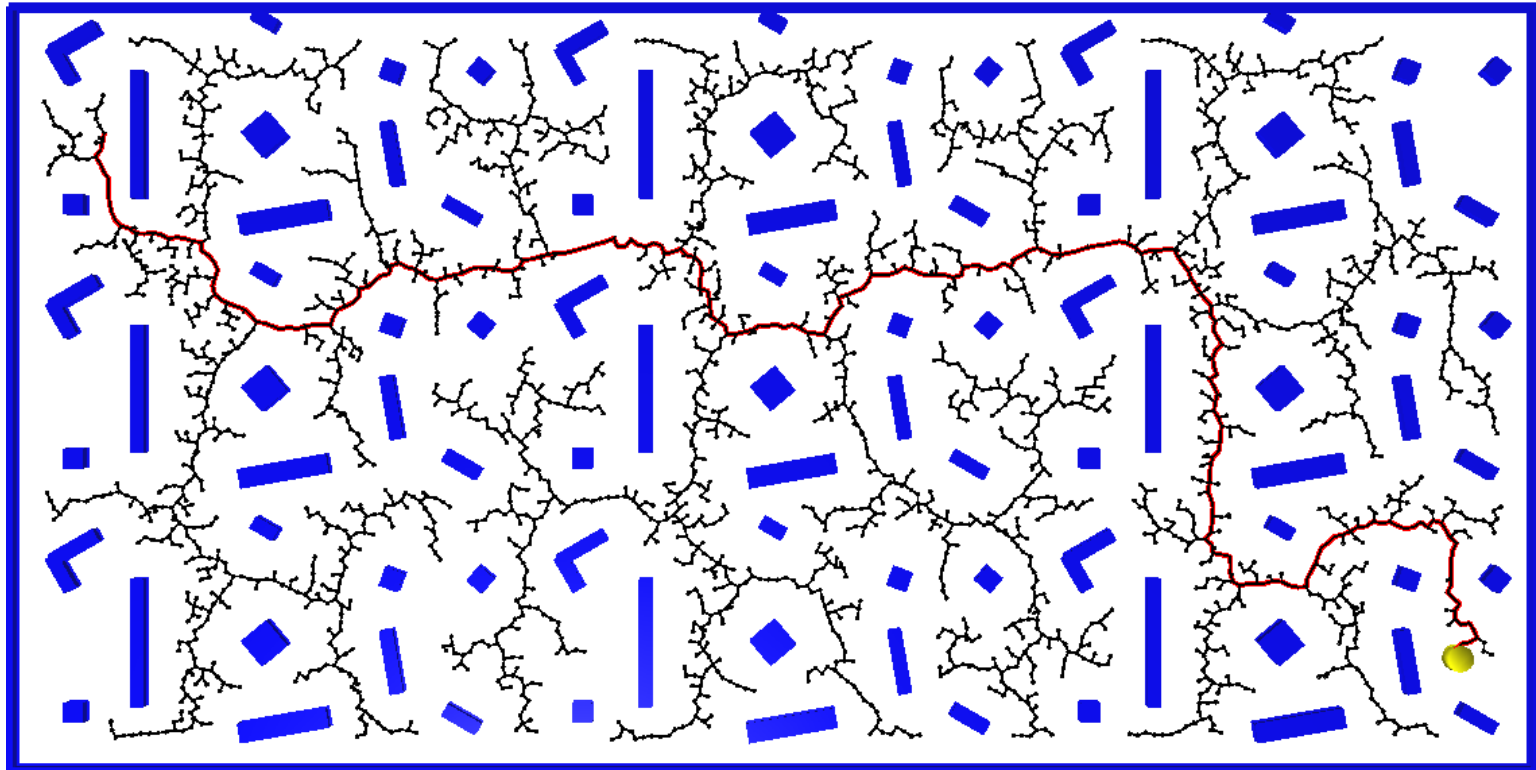
Feasible path planning

- RRT [LaValle and Kuffner, 2001]
 - + produces collision-free paths rapidly
 - - not asymptotically optimal



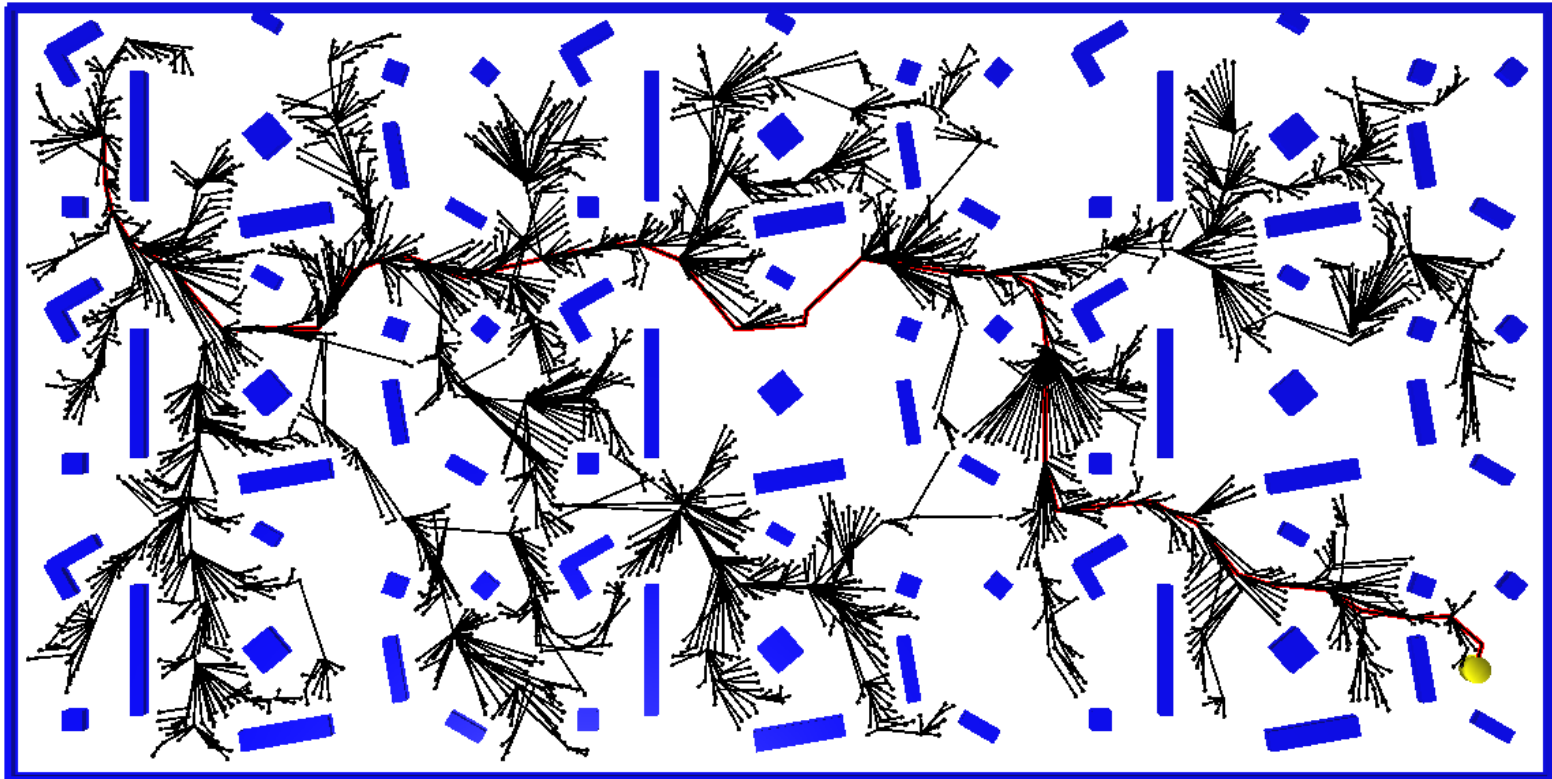
Cost-space path planning

- Transition-based RRT (T-RRT) [Jaillet et al., 2010]
 - + produces high-quality paths (thanks to its transition test)
 - + cost-based node creation (configuration cost)
 - - regular edge creation
 - - not asymptotically optimal



Optimal path planning

- RRT* [Karaman and Frazzoli, 2011]
 - + produces near-optimal paths
 - + cost-based edge management (path cost)
 - - regular node creation
 - - converges slowly in high-dimensional spaces

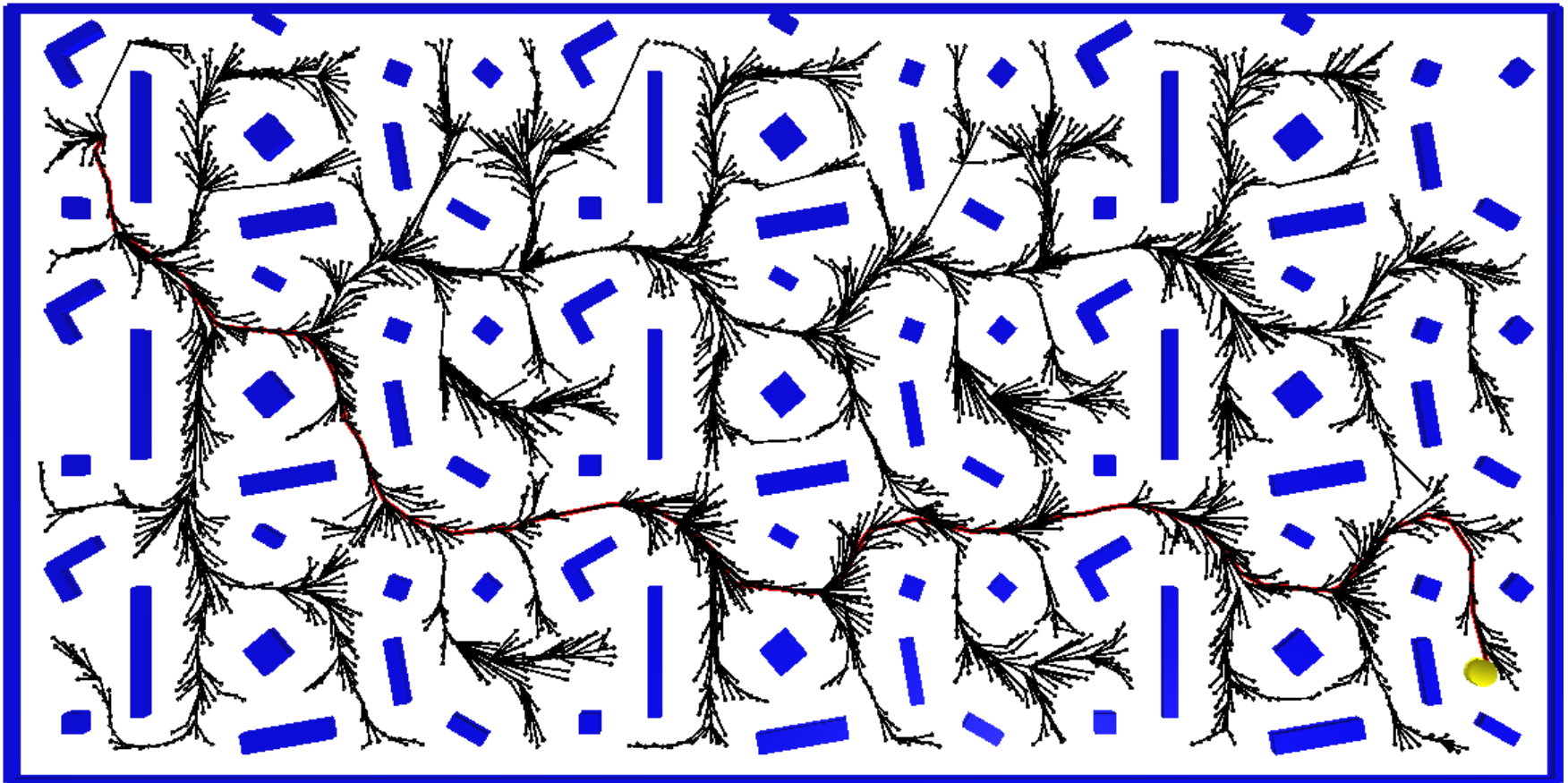


Two new algorithms for efficient **optimal path planning**

- Idea: combine the beneficial concepts underlying RRT* and T-RRT in two different ways
 - cost-based node creation (configuration cost)
 - cost-based edge management (path cost)
- Two new algorithms
 - Transition-based RRT* (T-RRT*)
 - Anytime T-RRT (AT-RRT)
- Theoretical guarantees
 - probabilistic completeness
 - asymptotic optimality

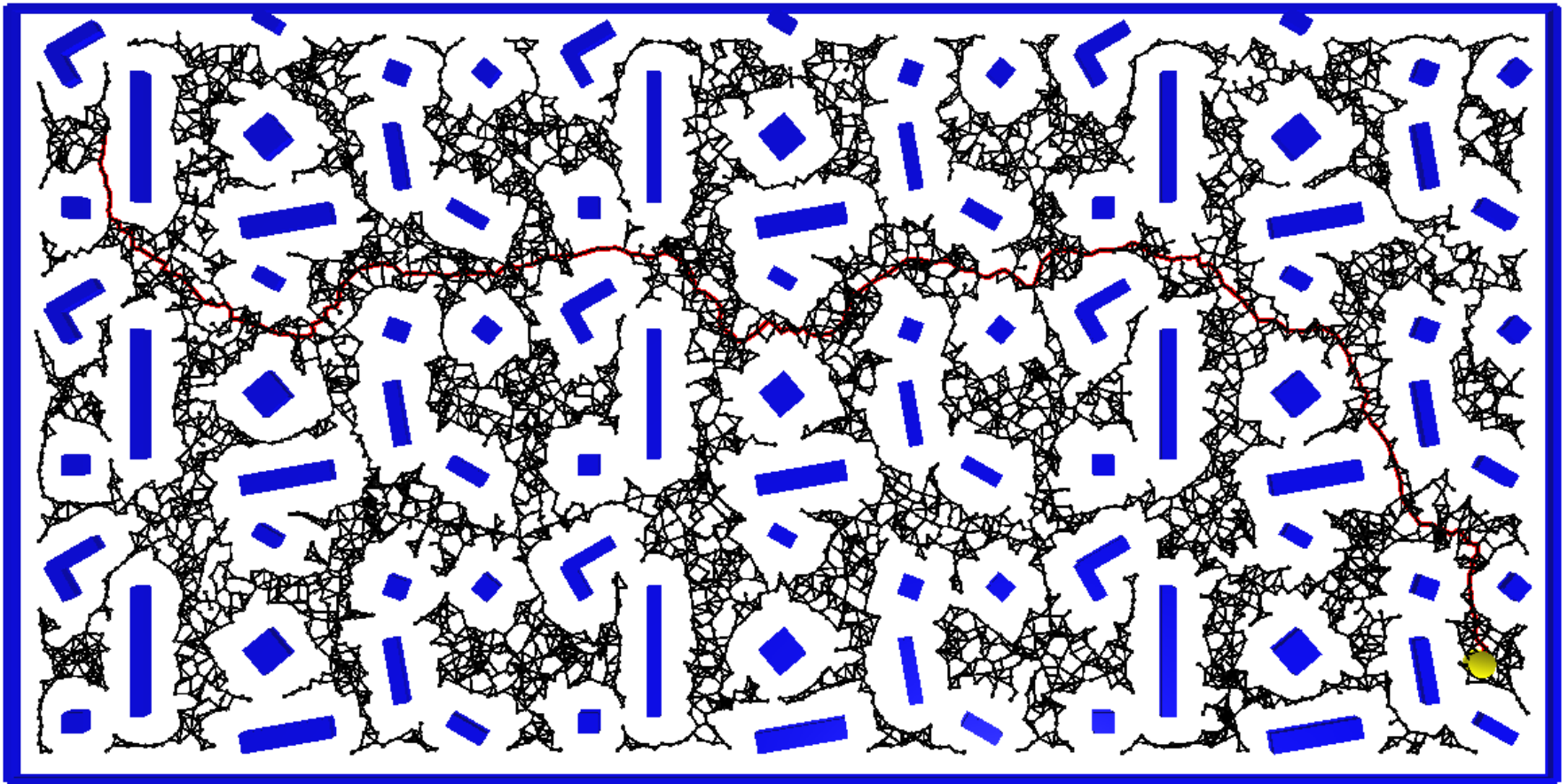
Transition-based RRT* (T-RRT*)

- Idea: apply the transition test of T-RRT

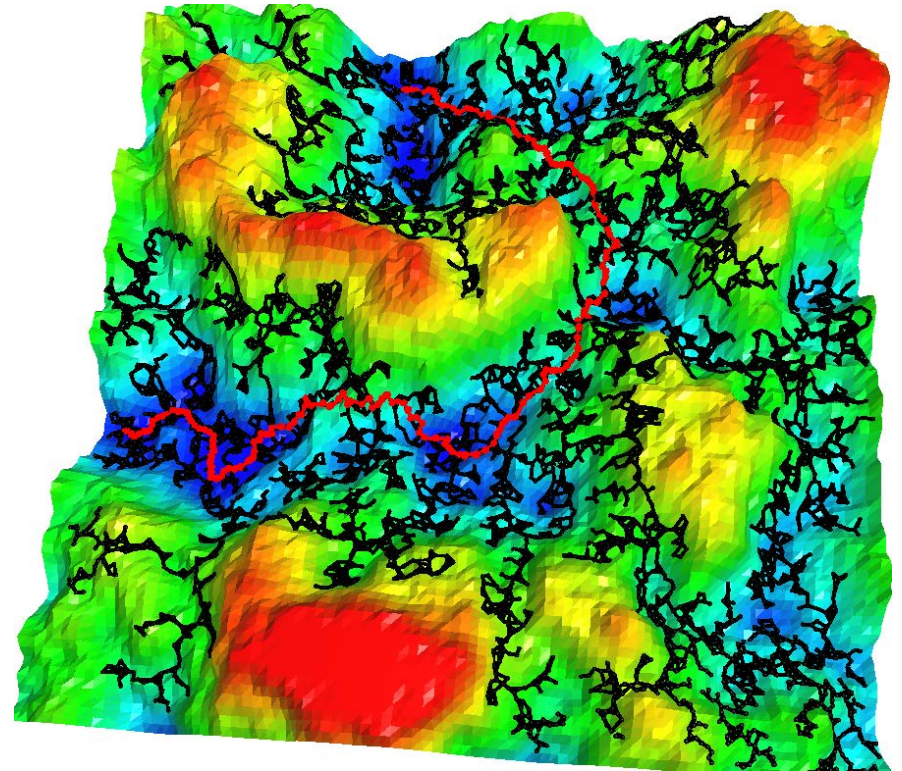
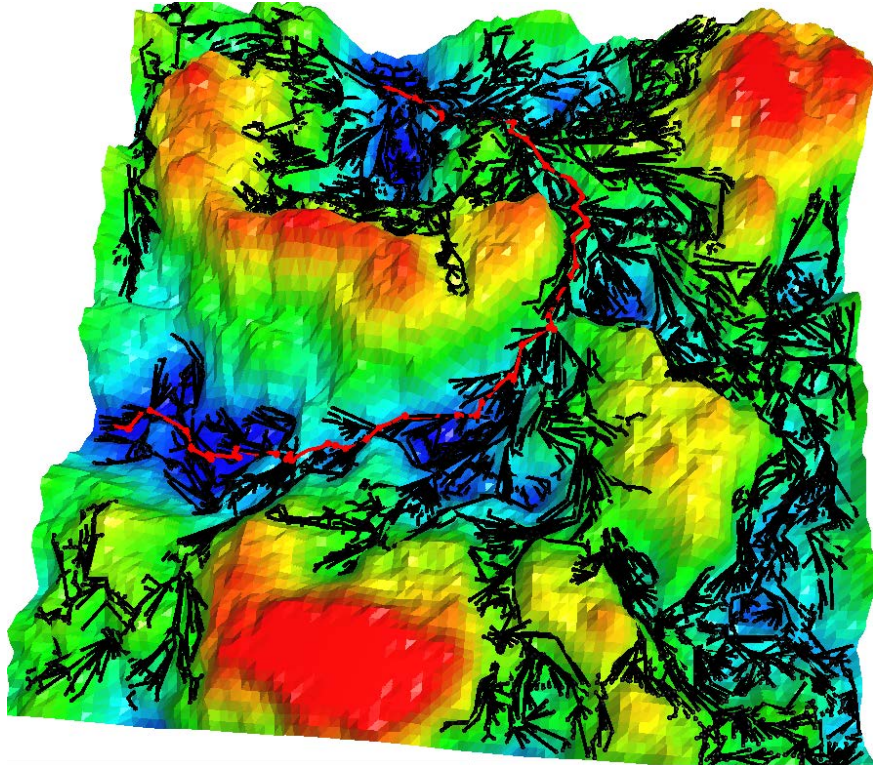


Anytime T-RRT (AT-RRT)

- Idea: add useful cycles to the graph



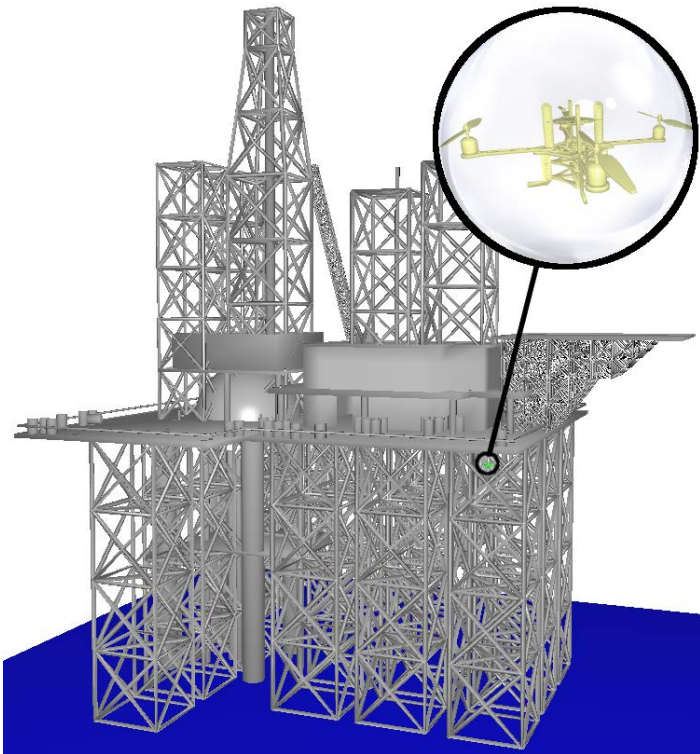
T-RRT* vs. AT-RRT



Experimental results

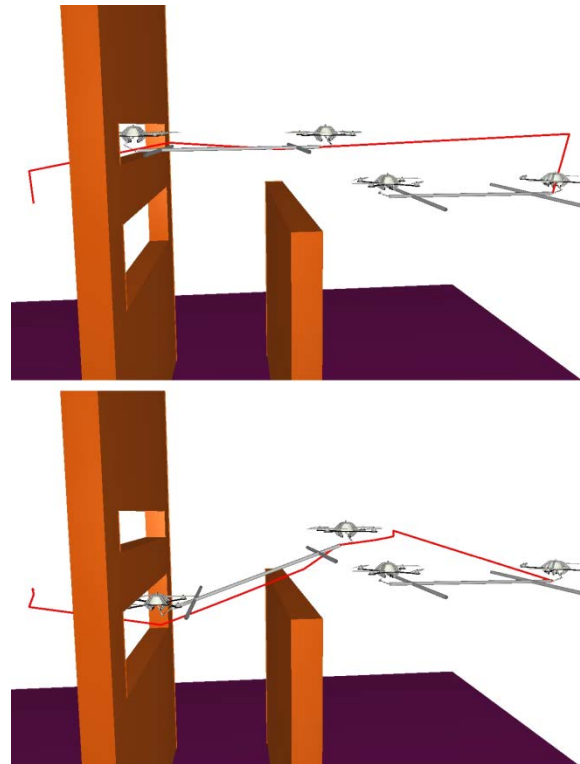
- T-RRT* and AT-RRT converge faster than RRT* on difficult problems

large-scale workspace



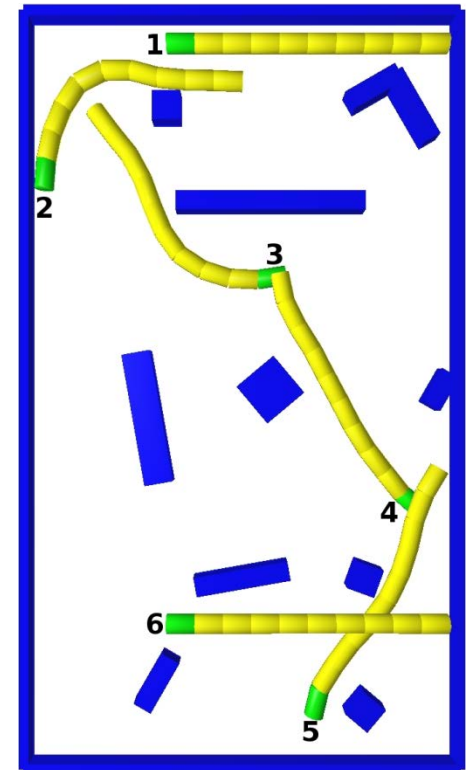
Inspection

space with several homotopic classes



Transport

high-dimensional space



Snake

Convergence analysis

