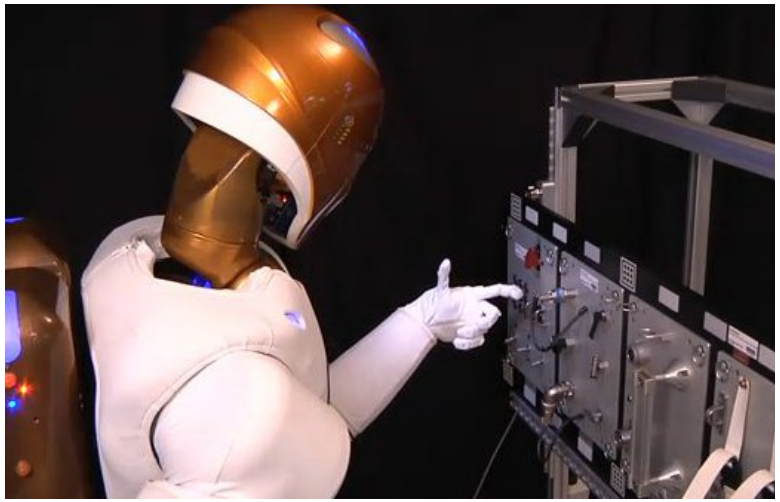
Benchmarking: Modern Tools for Motion Planning

Tutorial on Motion Planning for Mobile Manipulation
ICRA 2013

Which Planner Do You Choose?



So You Think You Can Plan?

- *One planner to rule them all* does not exist
  - Quality metric is problem dependent
- Comparison of motion planners is difficult
- How do you make a fair comparison?

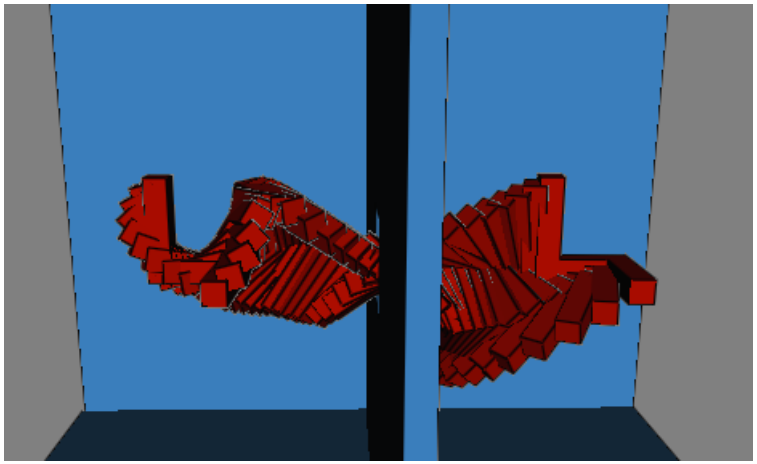
Still an open question…

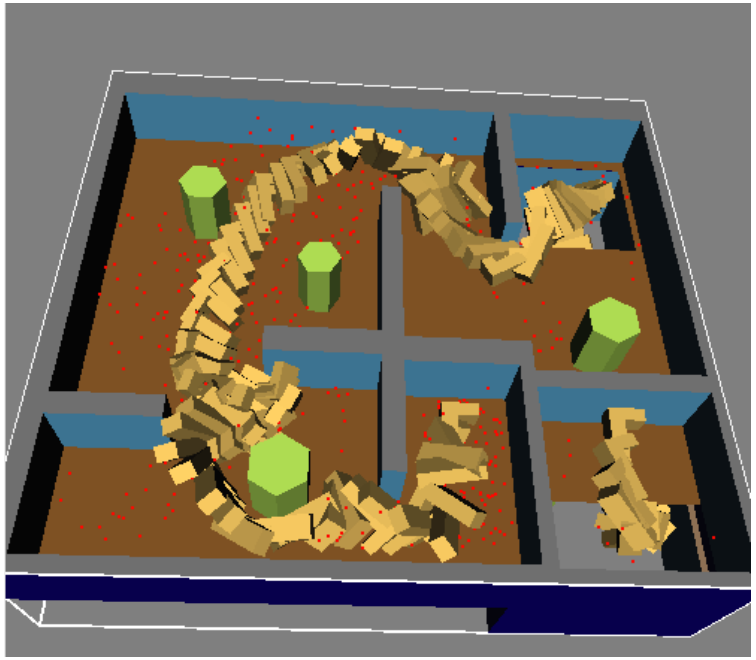
Benchmarking

- Good for more than just comparison!
  - Parameter sweeps
  - Rigorous testing
  - Performance evaluation over time
- Generic benchmarking facilities exist:
  - OMPL Benchmark class
  - MoveIt! Benchmarking and Warehouse
  - PlannerArena.org

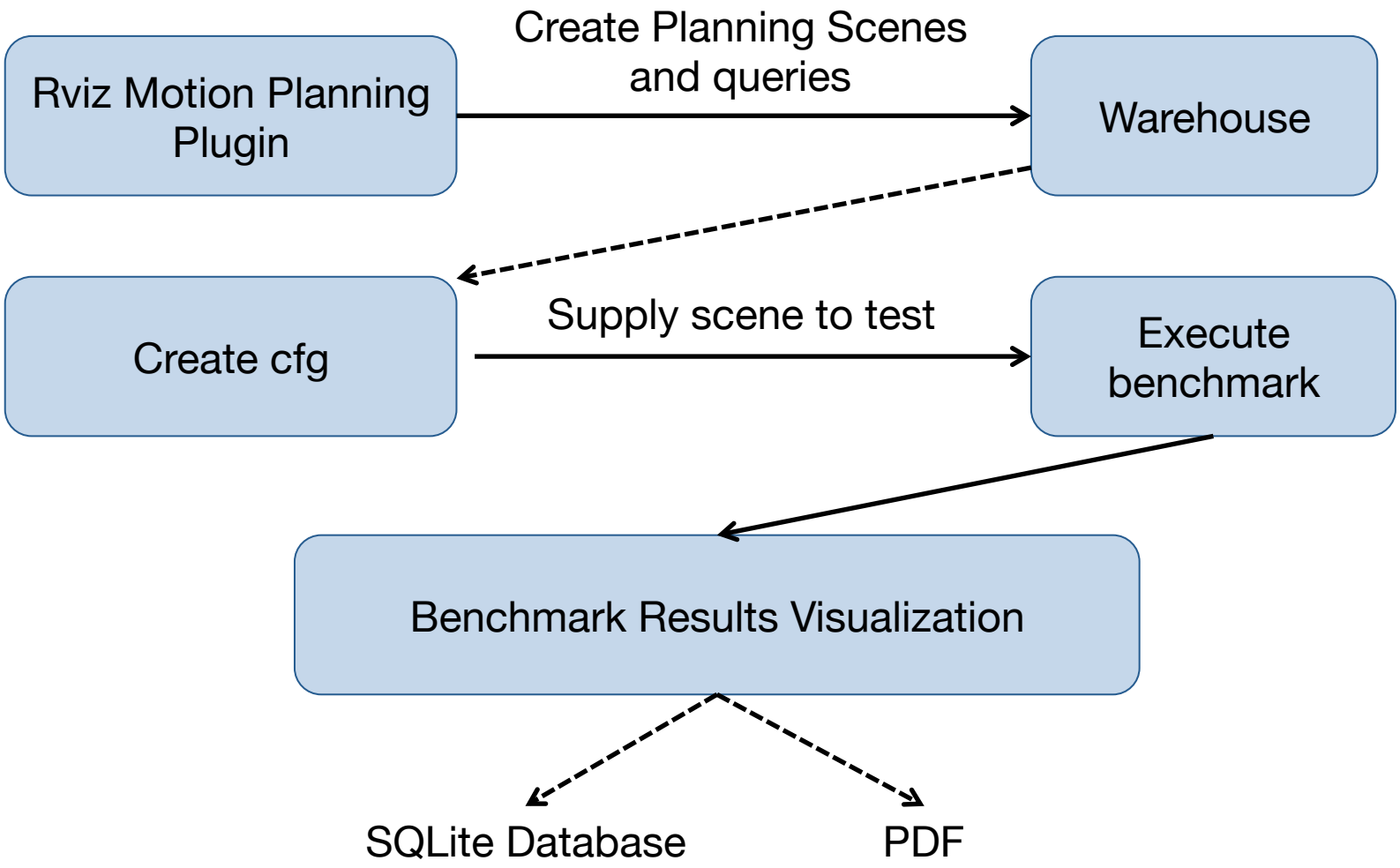
OMPL Benchmark Class

- Sampling-based planners
- Specify a start/goal state
  - Number of attempts
  - Time per attempt
  - Maximum memory usage
- SQLite database ⇒ PDF
- Scriptable benchmarking:
  - Sampling strategies
  - Planner parameters
  - …

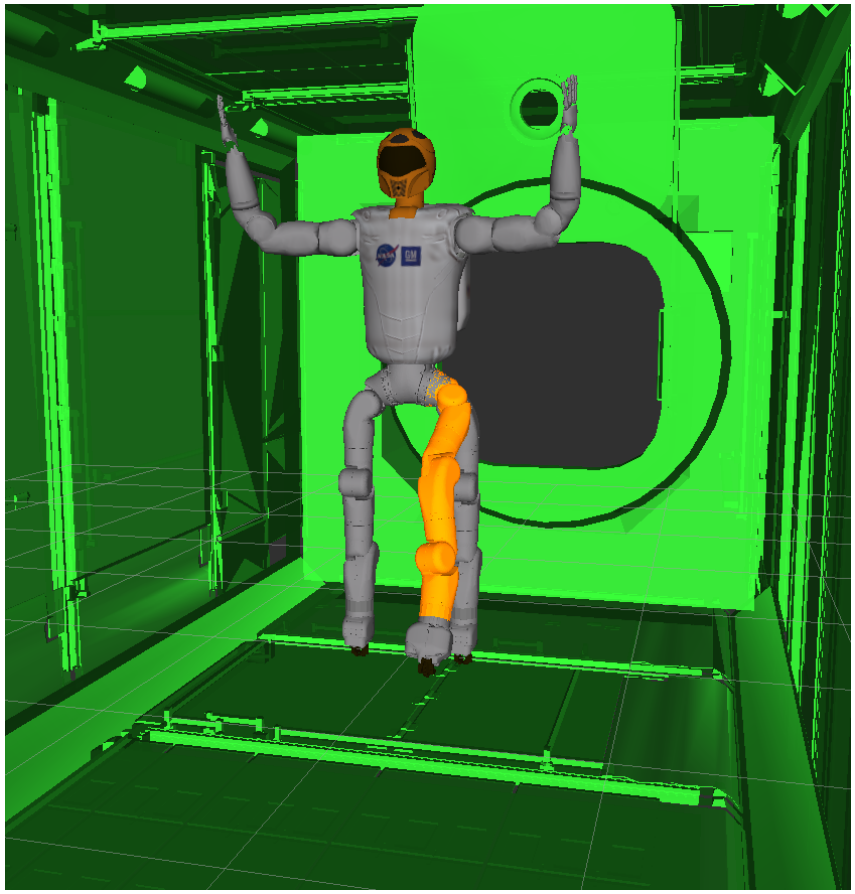




MoveIt! Benchmarking



MoveIt! Benchmarking



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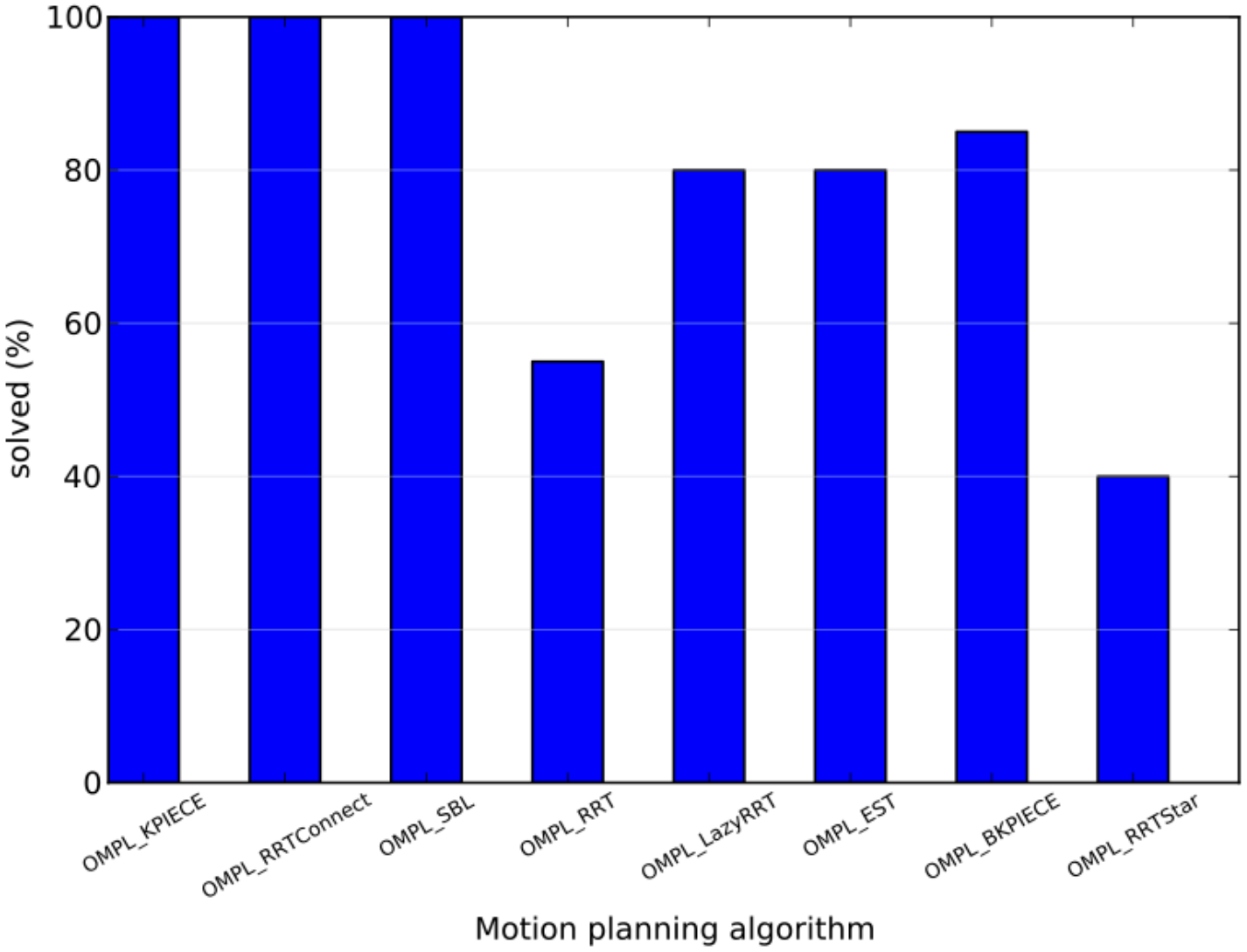
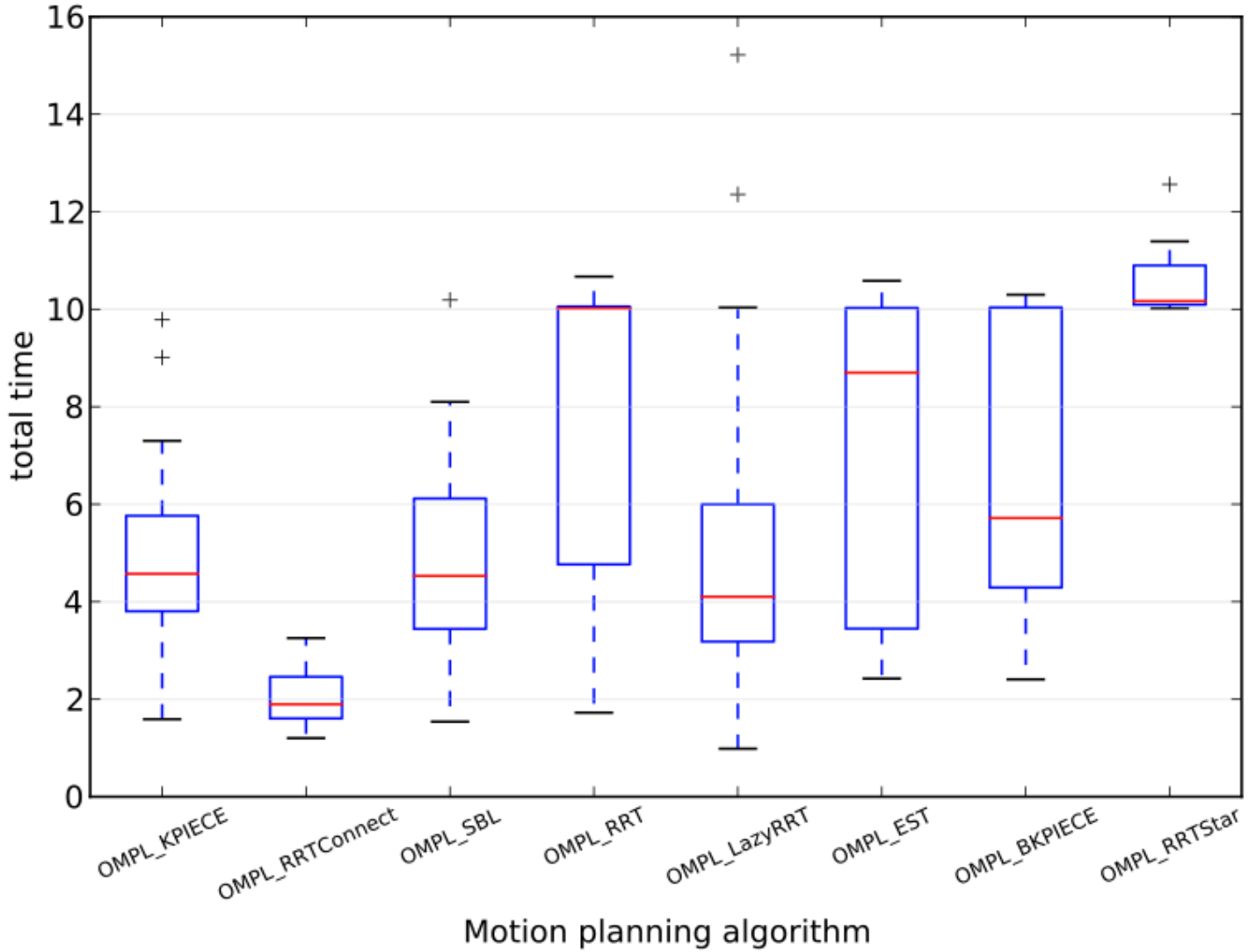
[scene]
name=ISS
Output=ISS.log
runs=20
timeout=10.0

[plugin]
name=ompl_interface/OMPLPlanner
planners=KPIECEkConfigDefault
         RRTConnectkConfigDefault
         SBLkConfigDefault
         RRTStarkConfigDefault
[plugin]
name=YourPlannerLib/YourPlanner
planners=SuperAwesomePlanner
         UnbelievablyGoodPlanner
```

MoveIt! Results Visualization



MoveIt! Results Visualization



plannerarena.org

Benchmarks for various motion planning algorithms

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Motivation

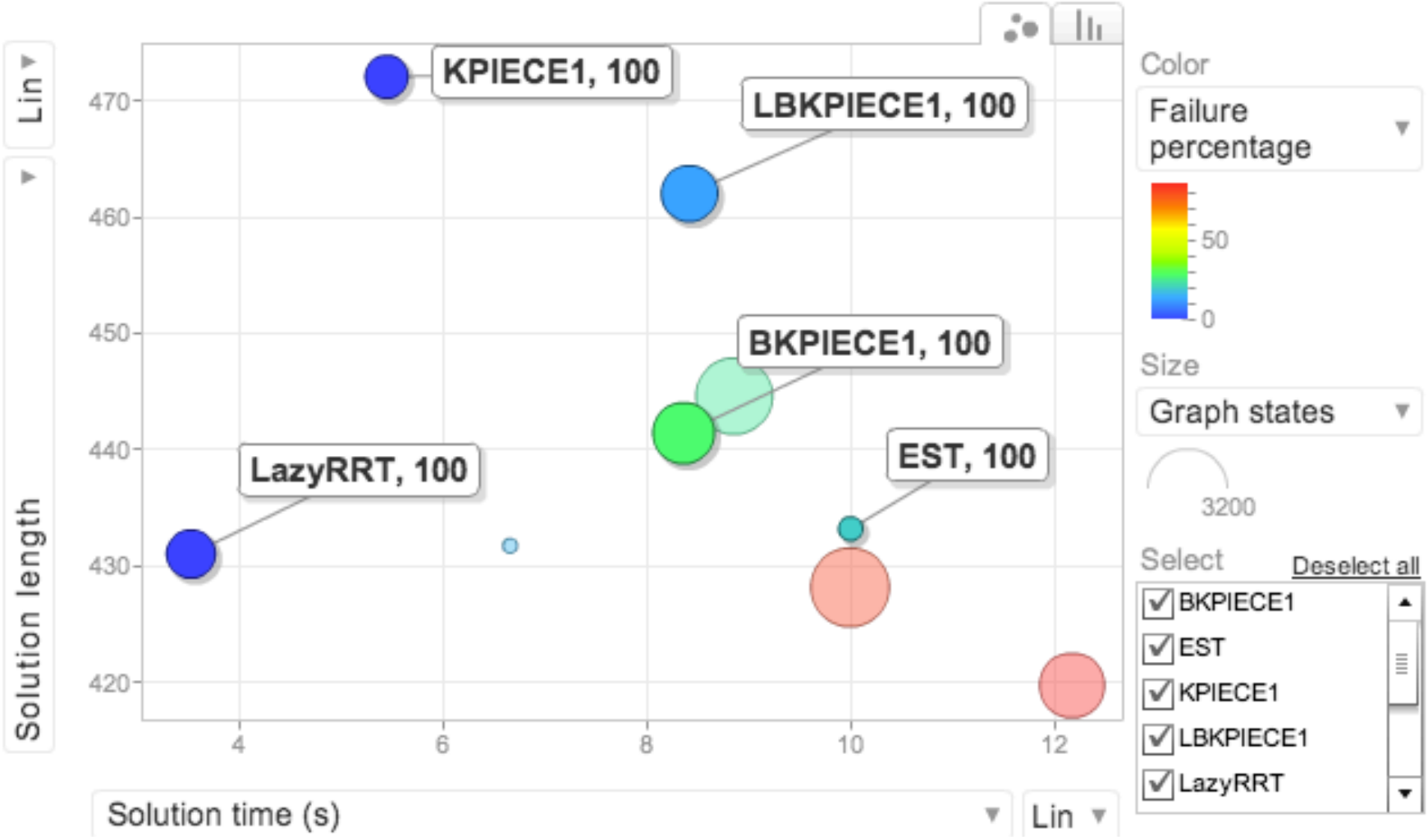
There is a multitude of motion planning algorithms. These algorithms can solve difficult planning problems, but with varying degree of success. There is no clear "best algorithm" among them, at least as of yet. One could probably count hundreds of variations of the popular sampling-based motion planning paradigm, hundreds of variations of popular AI-inspired discrete search algorithms, and many other exact and approximate methods. They all provide different guarantees and exhibit different performance characteristics, depending on the environment and the robot considered.

Given a motion planning problem, the question is, which motion planning algorithm should be used? Which class of algorithms is better suited for the problem (e.g., sampling-based PRM-like techniques, A*-like techniques)? Which ideas from that particular class of algorithms are appropriate? What parameter values should be used to configure a particular algorithm? How does performance vary with respect to a given user-specified metric? This website attempts to help in answering such questions (but does not directly answer them), and helps to pose new questions that will hopefully lead to the design of more powerful planning algorithms.

Approach

Relying on software advantages offered by motion planning libraries such as OMPL and middleware such as ROS, this website presents a multitude of benchmark results: many different planners evaluated on many different planning problems. These results are cumulated and shown in an easy to understand fashion.

PlannerArena.org



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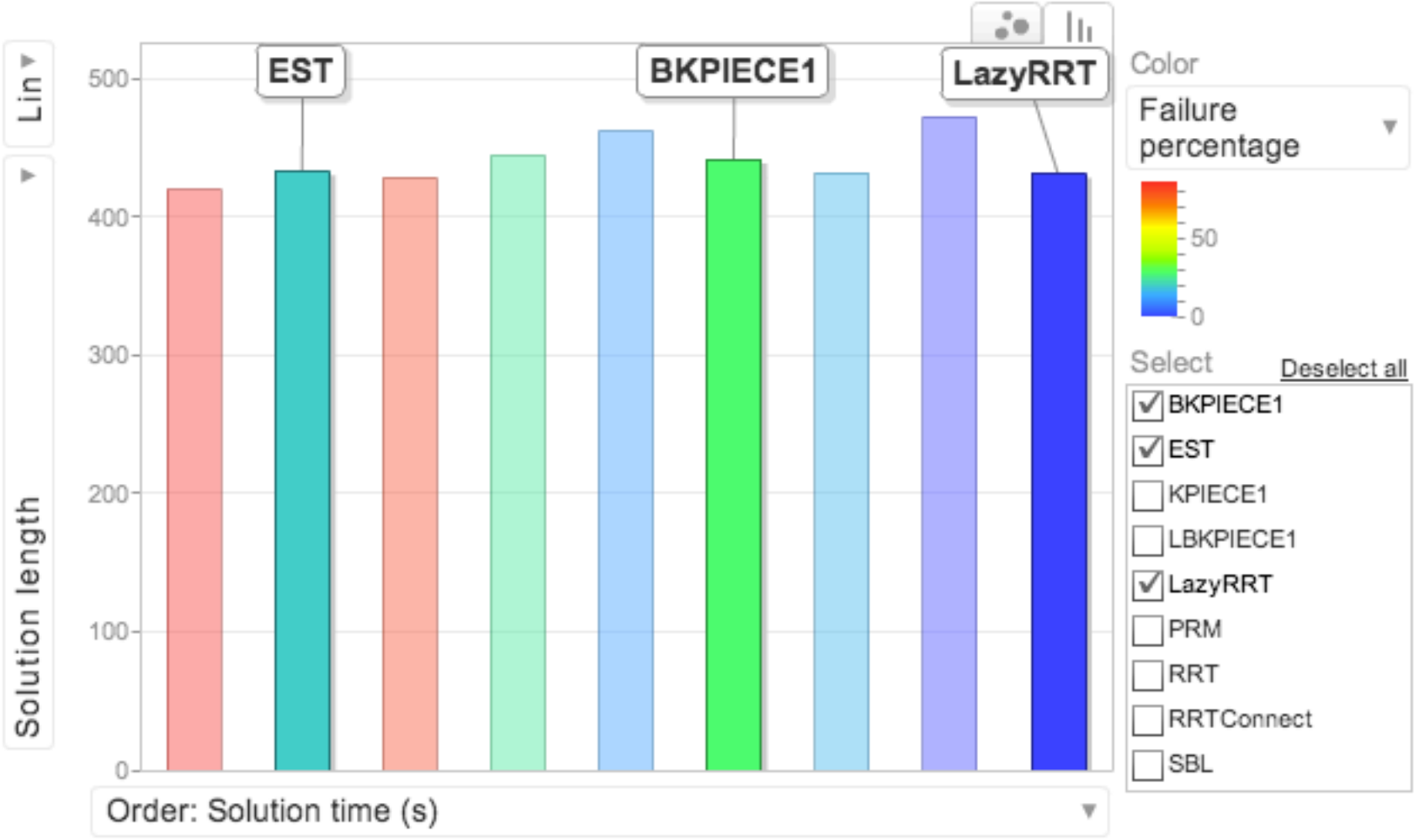

In Short…

- Important to find the best planner for your application
  - Benchmarking provides a vehicle for this
- Benchmarking is good for more than just comparing planners
- Multiple open-source tools available
- If you have a good problem / planner: *tell us!*