

Disclaimer

These slides are intended as presentation aids for the lecture. They contain information that would otherwise be too difficult or time-consuming to reproduce on the board. But they are incomplete, not self-explanatory, and are not always used in the order they appear in this presentation. As a result, these slides should not be used as a script for this course. I recommend you take notes during class, maybe on the slides themselves. It has been shown that taking notes improves learning success.

Reading for this set of slides

- [Planning Algorithms](#) (Steve LaValle)
 - 4 The Configuration Space (4.1 – 4.3)
 - 5 Sampling-based Motion Planning (5.1, 5.5, 5.6, also skim the remaining sections)
- Markus Rickert and Arne Sieverling and Oliver Brock. [Balancing Exploration and Exploitation in Sampling-Based Motion Planning \(link to PDF\)](#). *IEEE Transactions on Robotics* 30(6):1305-1317, 2014.

Please note that this set of slides is intended as support for the lecture, not as a stand-alone script. If you want to study for this course, please use these slides in conjunction with the indicated chapters in the text books. The textbooks are available online or in the TUB library (many copies that can be checked out for the entire semester. There are also some aspects of the lectures that will not be covered in the text books but can still be part of the homework or exam. For those It is important that you attend class or ask somebody about what was covered in class.

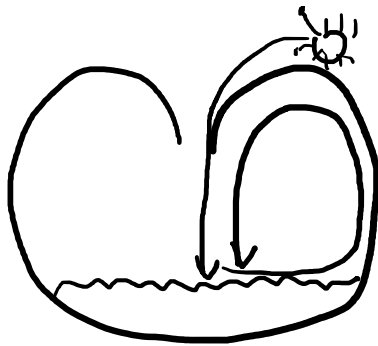
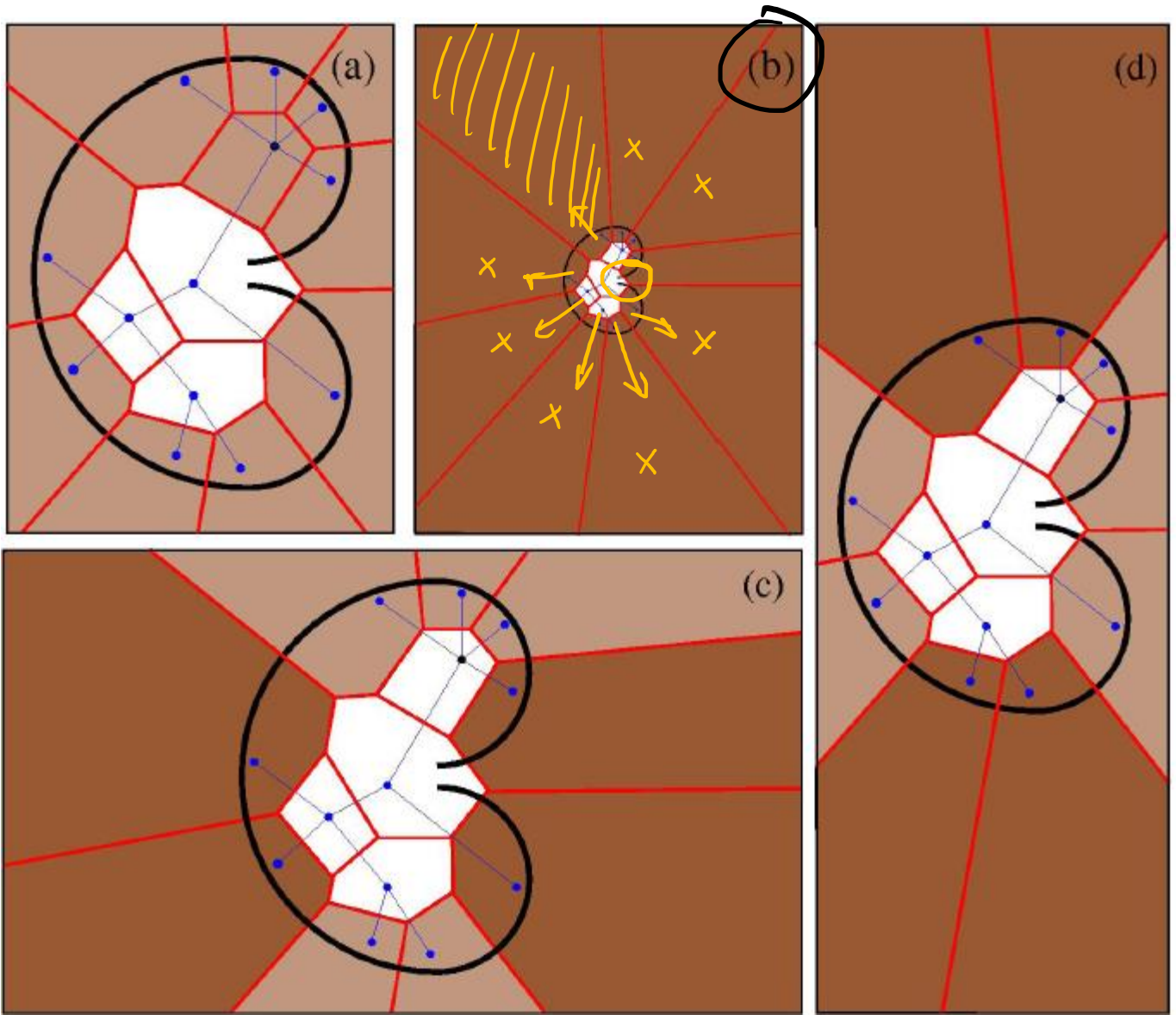


Robotics

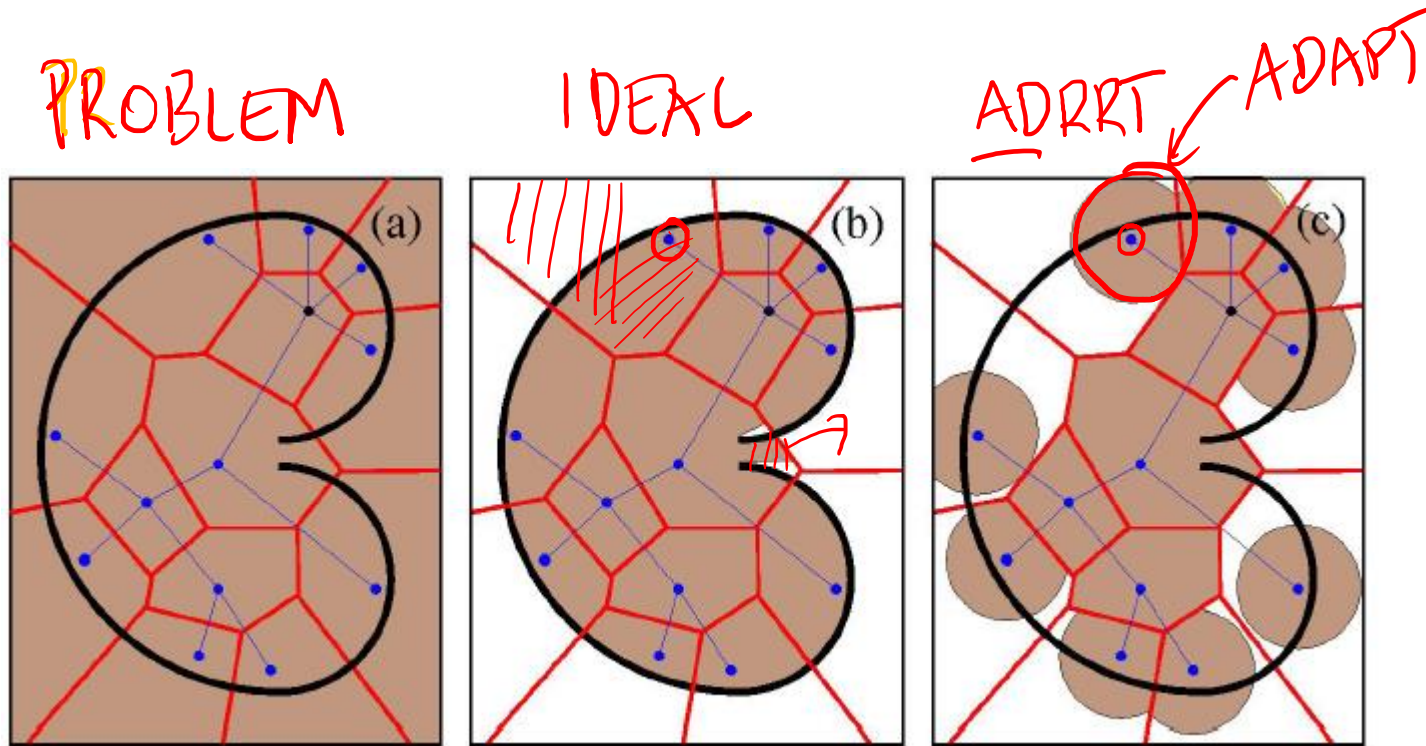
RRT: Addressing the Narrow Passage Problem

TU Berlin

Oliver Brock



Adaptive Domain RRT



The Ideal “Planner” or Search

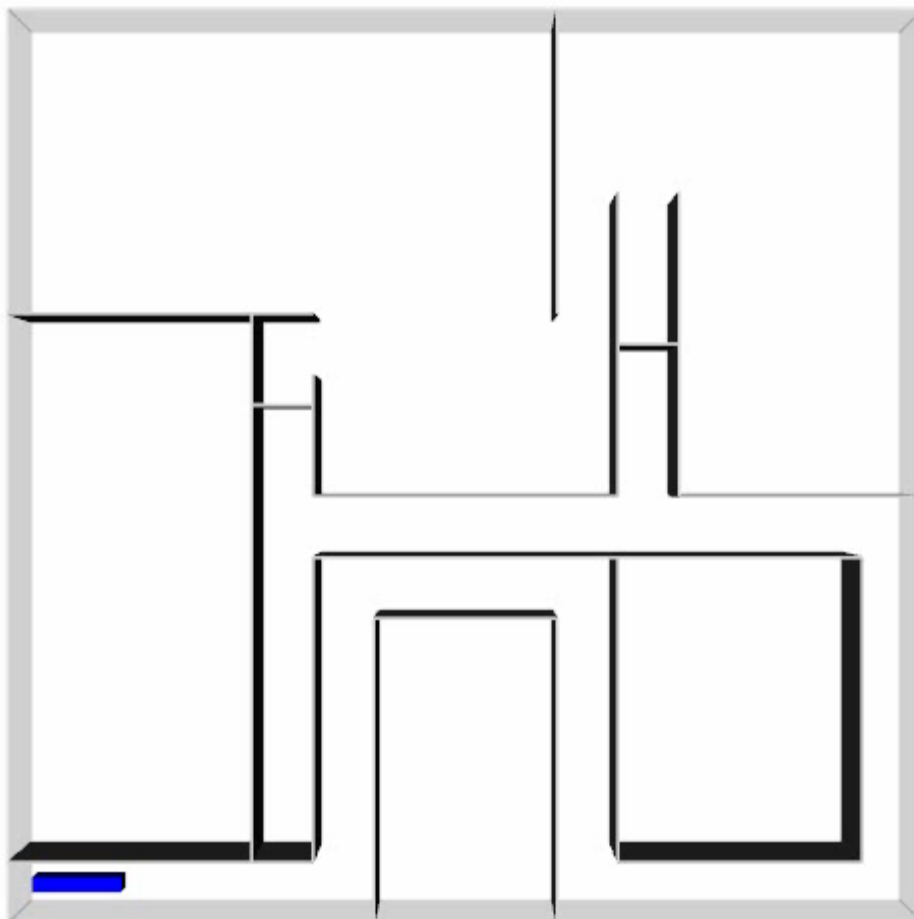
UNINFORMED

INFORMED

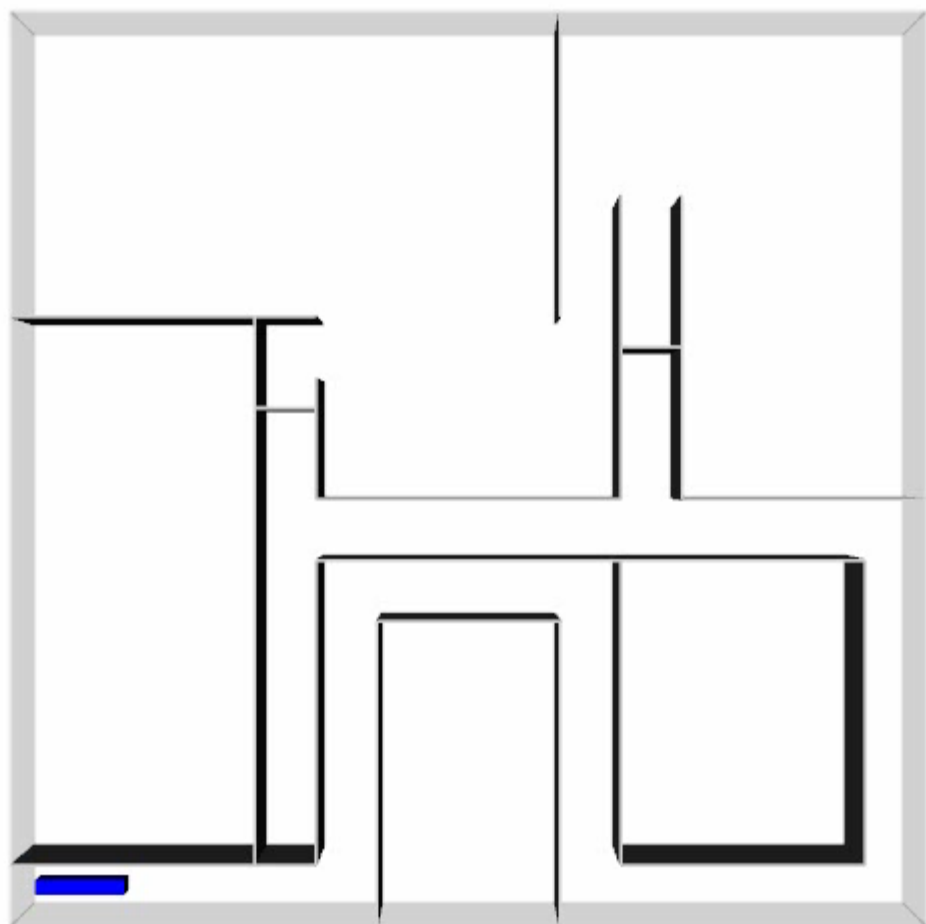
EXPLORATION

EXPLOITATION



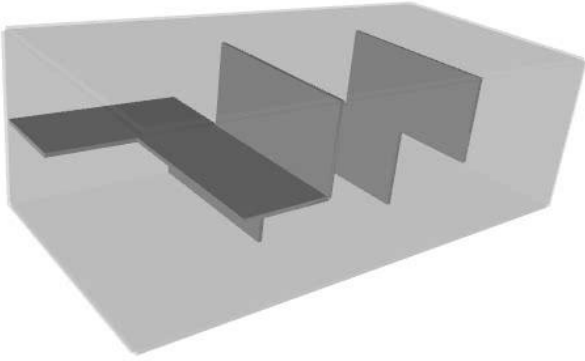


ADD-RRT: Jaillet, Yershova, LaValle, Simeon 2005



Exploiting workspace information

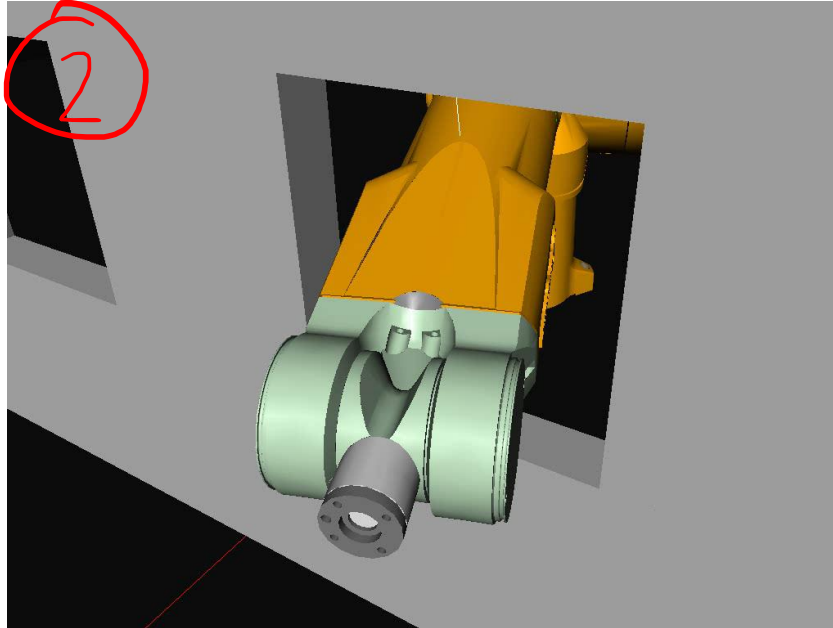
①



Workspace connectivity

$$\tau = \underline{J^T F}$$

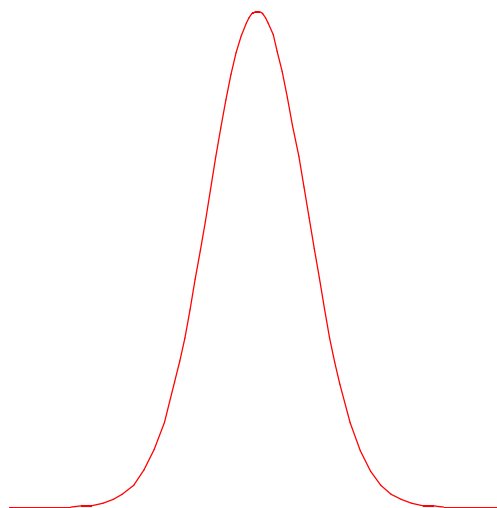
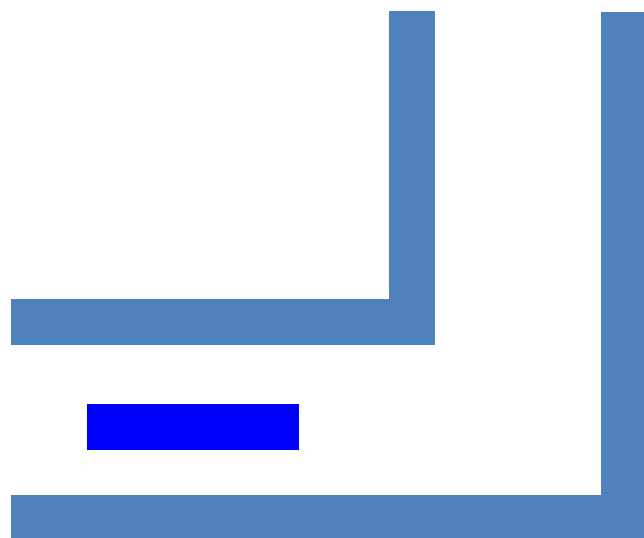
②



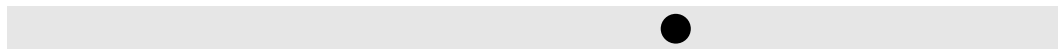
Proximity to obstacles !

$$\tau = \sum_i \underline{J_i^T F_i}$$

Balancing exploration and exploitation

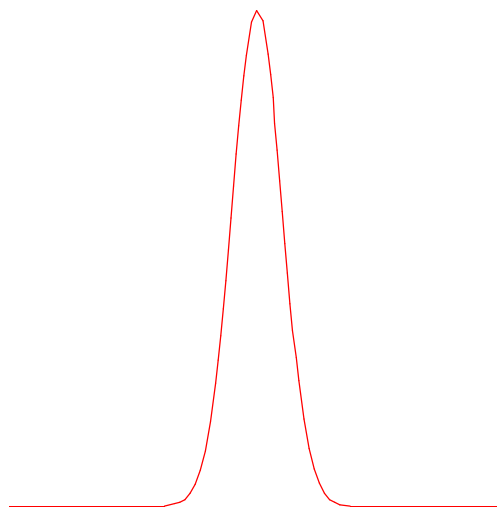
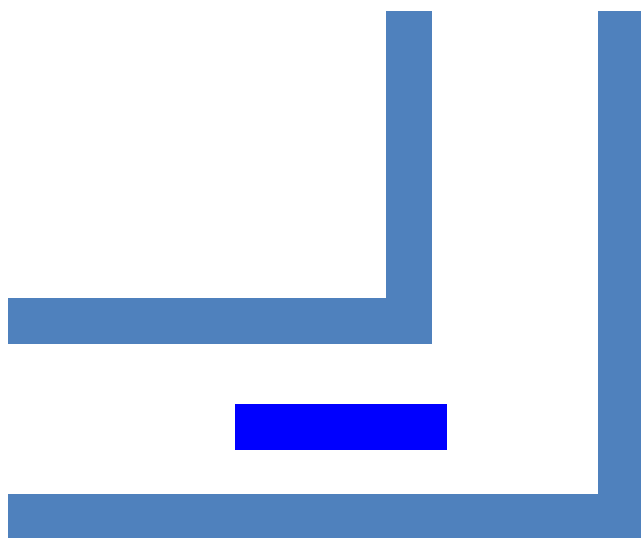


EXPLORATION

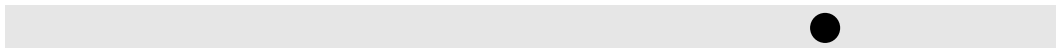


EXPLOITATION

Balancing exploration and exploitation

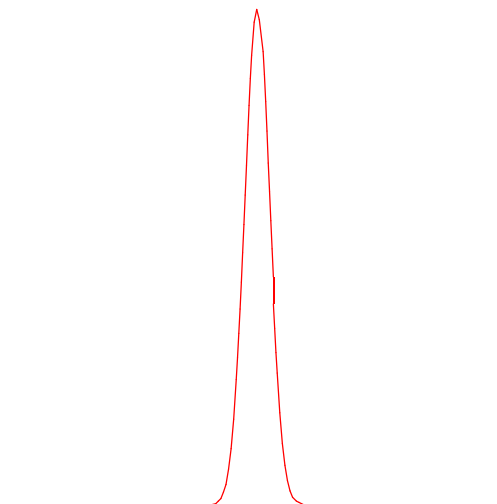
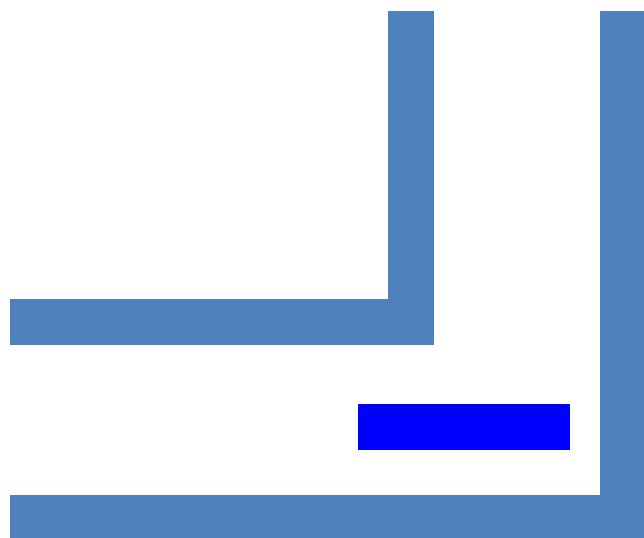


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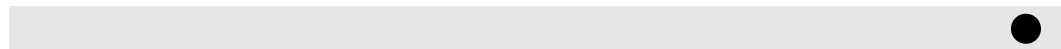


EXPLOITATION

Balancing exploration and exploitation

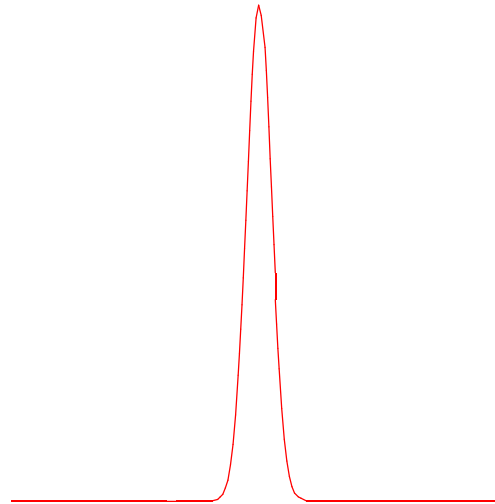
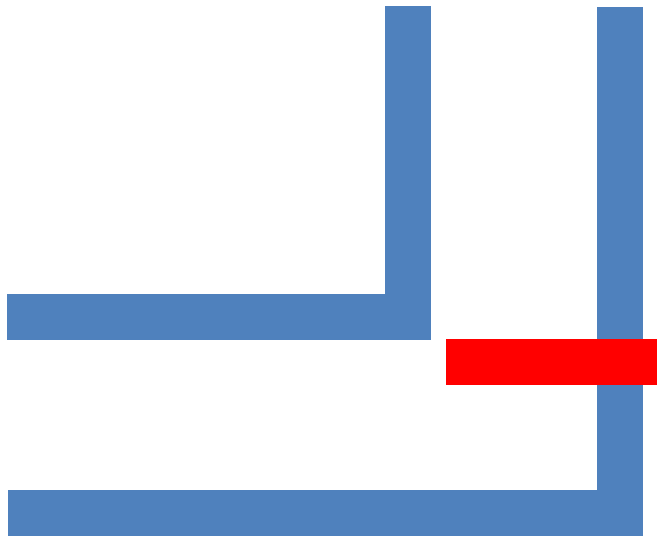


EXPLORATION



EXPLOITATION

Balancing exploration and exploitation

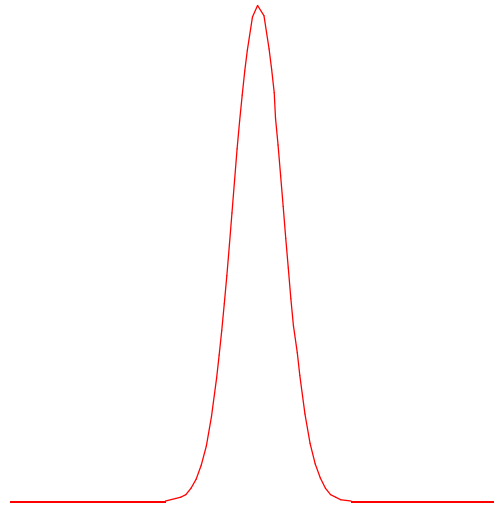
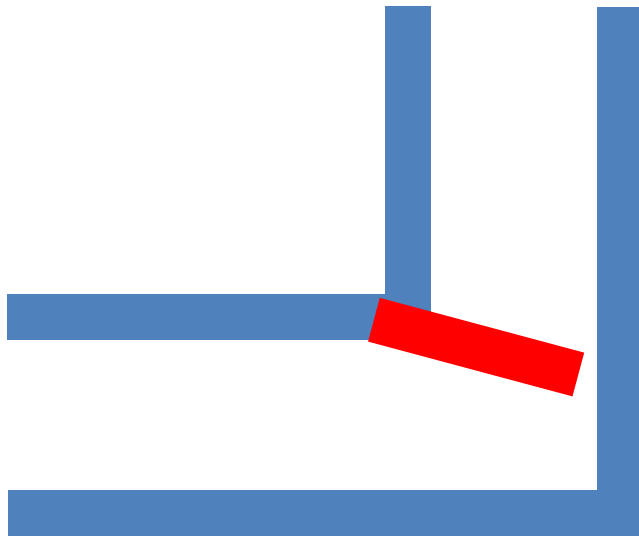


EXPLORATION



EXPLOITATION

Balancing exploration and exploitation

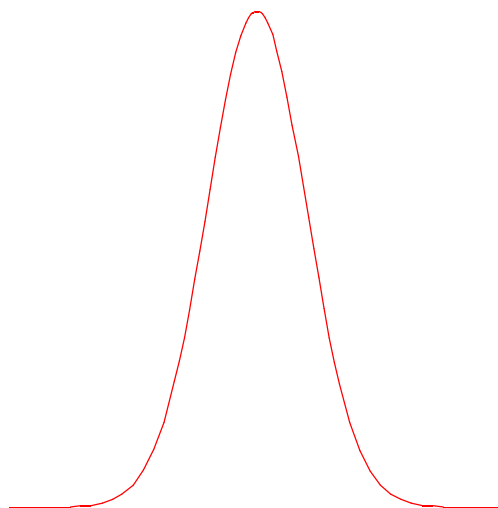
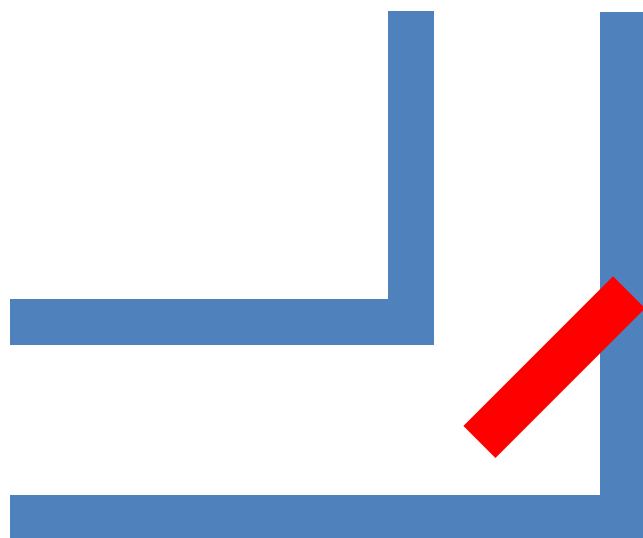


EXPLORATION

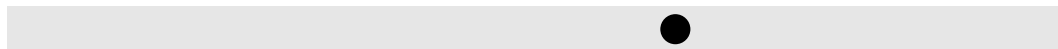


EXPLOITATION

Balancing exploration and exploitation

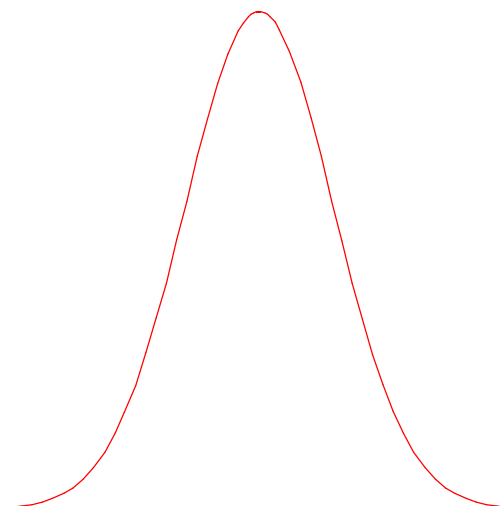
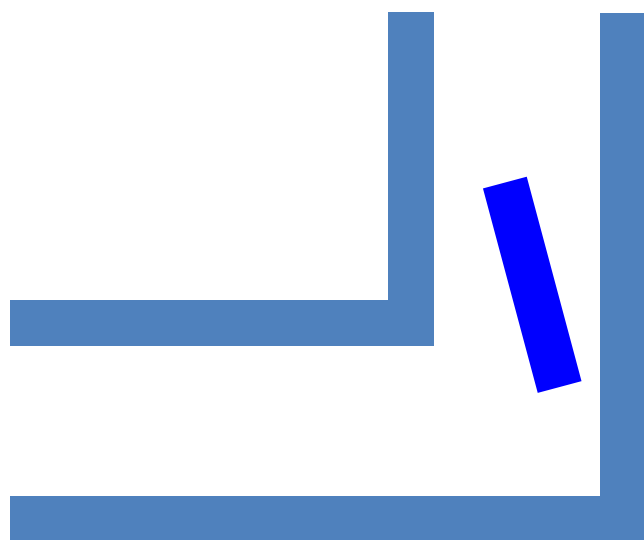


EXPLORATION



EXPLOITATION

Balancing exploration and exploitation

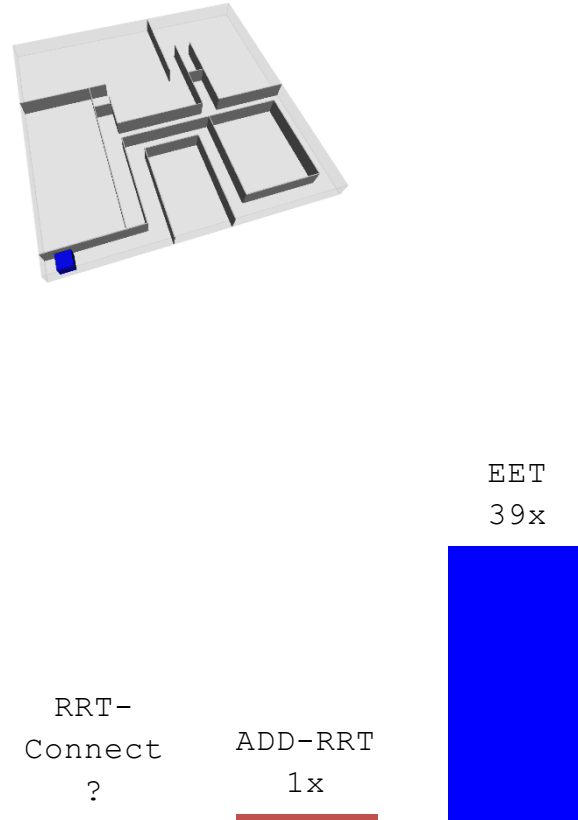
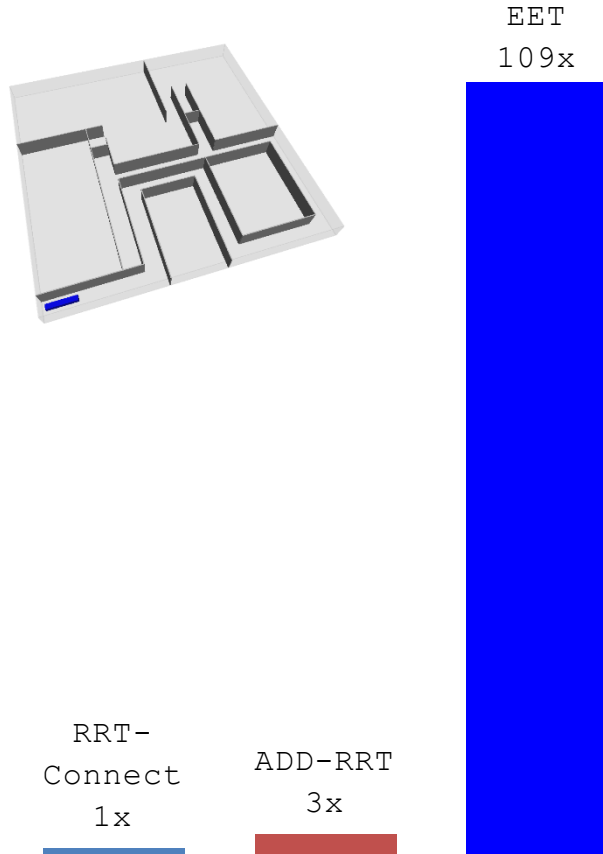


EXPLORATION



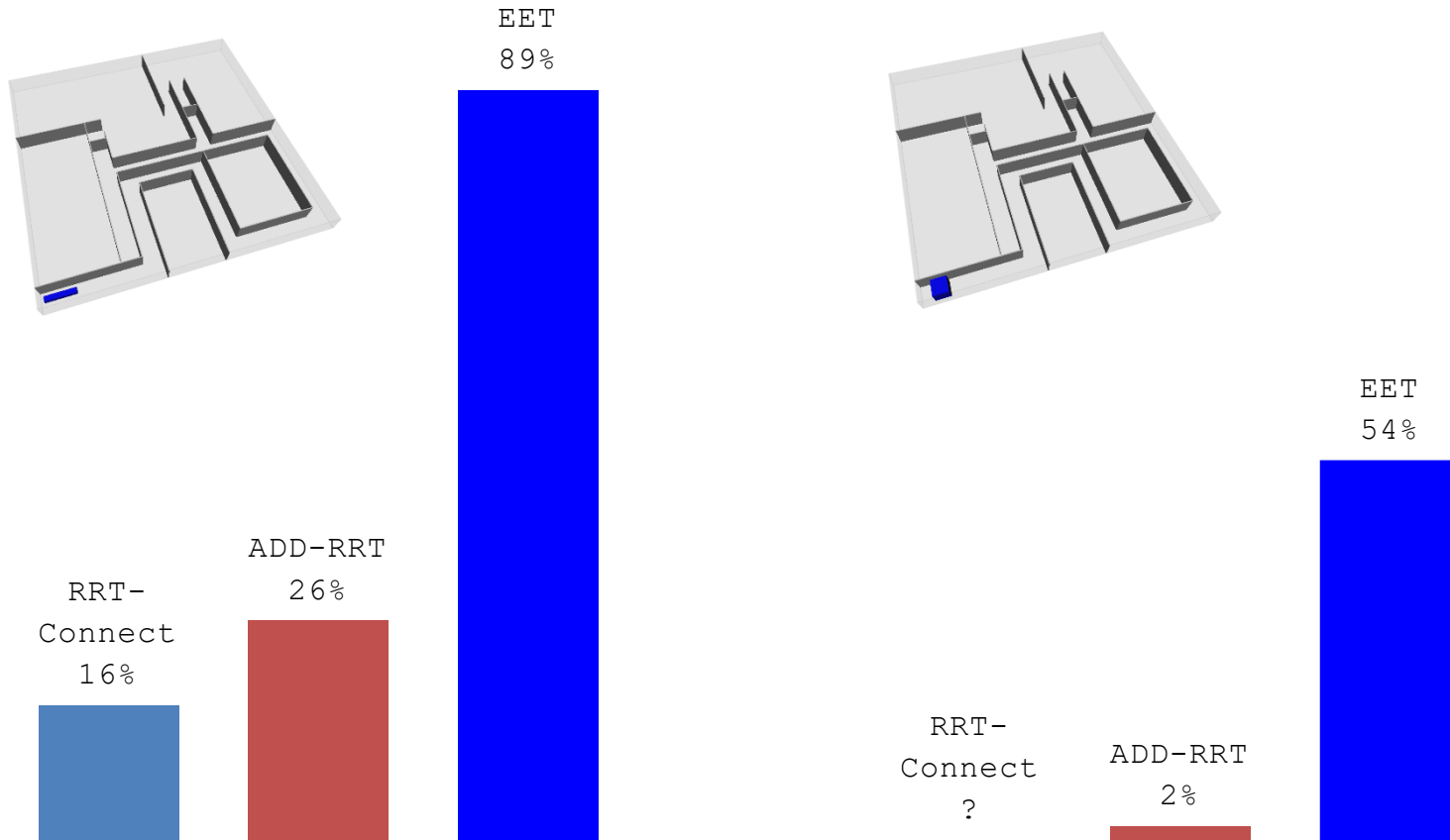
EXPLOITATION

Speedup



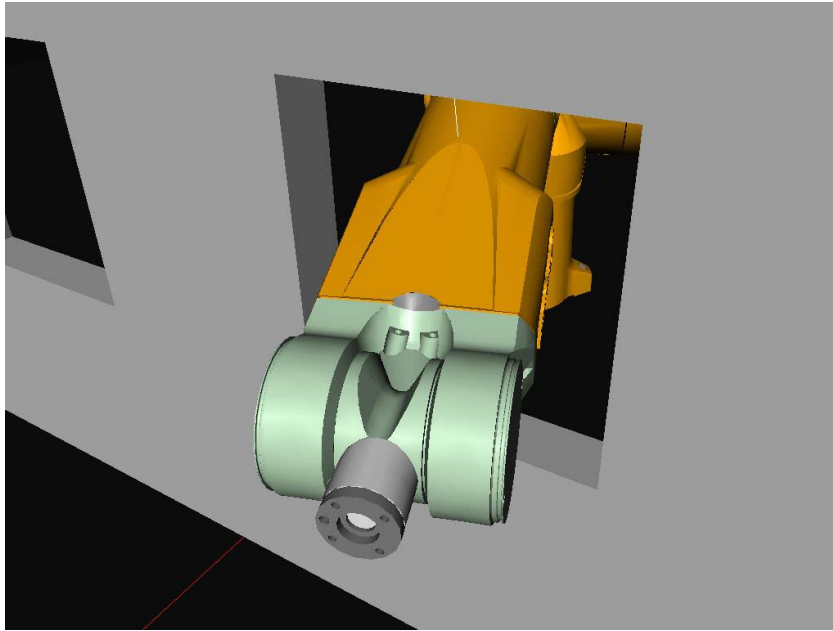
RRT-Connect: Kuffner and LaValle 2000
ADD-RRT: Jaillet, Yershova, LaValle, Simeon 2005

Effectiveness of exploitation (% of non-colliding samples)



RRT-Connect: Kuffner and LaValle 2000
ADD-RRT: Jaillet, Yershova, LaValle, Simeon 2005

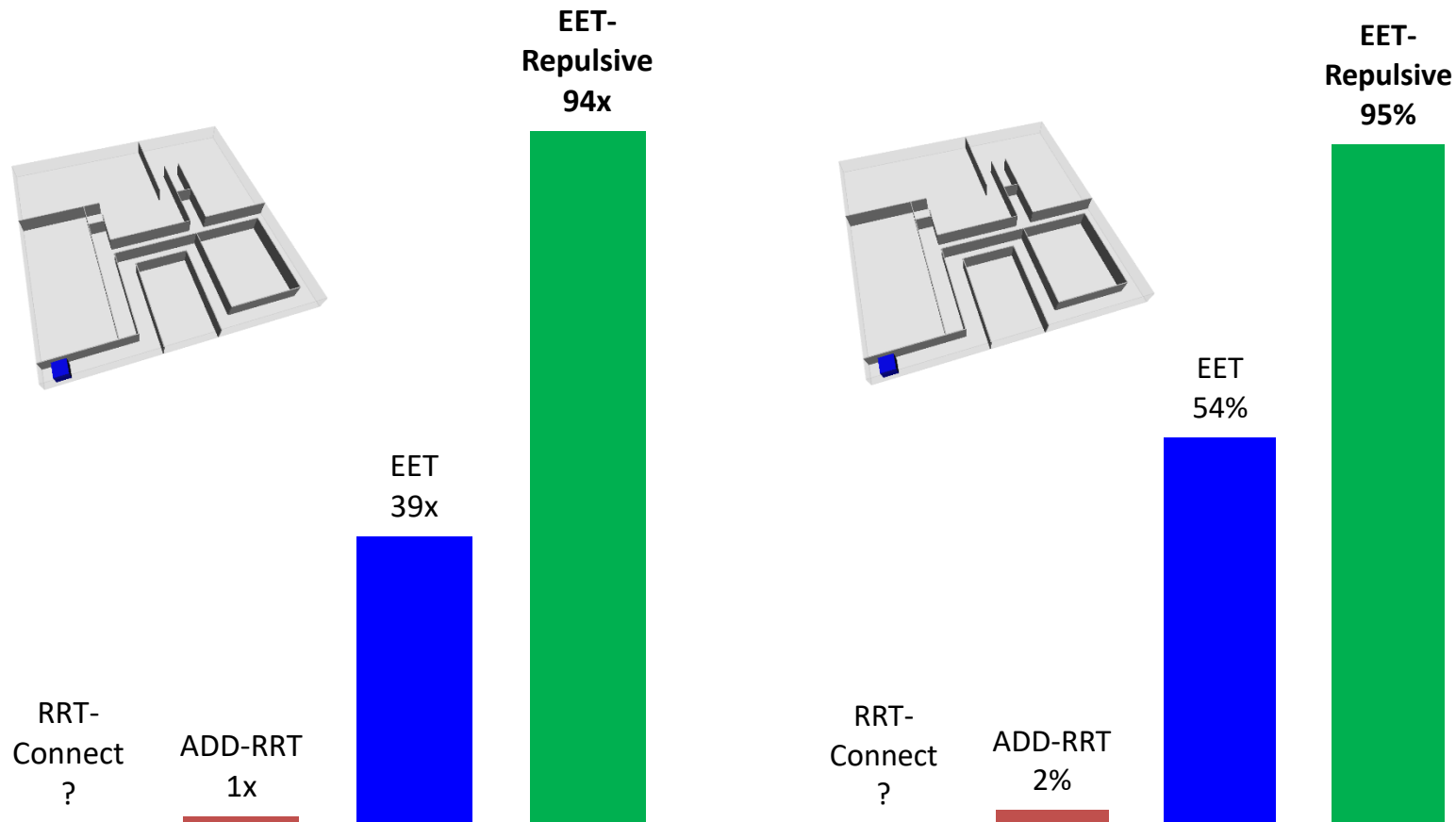
More information for better exploitation



Repulsive forces

$$\tau = \sum_i J_i^T F_i$$

Speedup / Effectiveness of exploitation



RRT-Connect: Kuffner and LaValle 2000

ADD-RRT: Jaillet, Yershova, LaValle, Simeon 2005

