Towards Guiding Semi-Autonomous Vehicles

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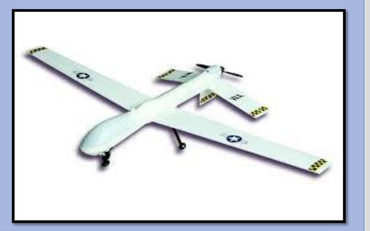
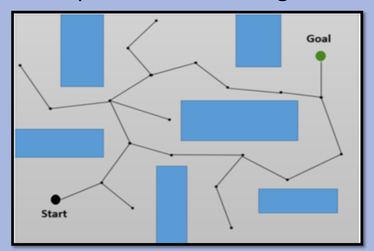
What is Motion Planning?

- The problem of finding a valid path from a start to a goal configuration
- Applications: robotics, biology, virtual reality, autonomous vehicles



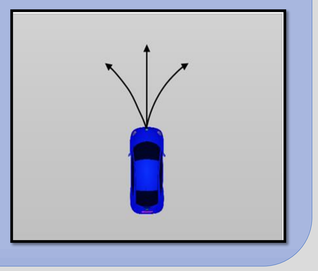
Sampling-Based Planning

- Randomly samples robot configurations
- Connects nearby configurations to form a roadmap (graph) which encodes a set of paths
- Extracts a valid path from start to goal

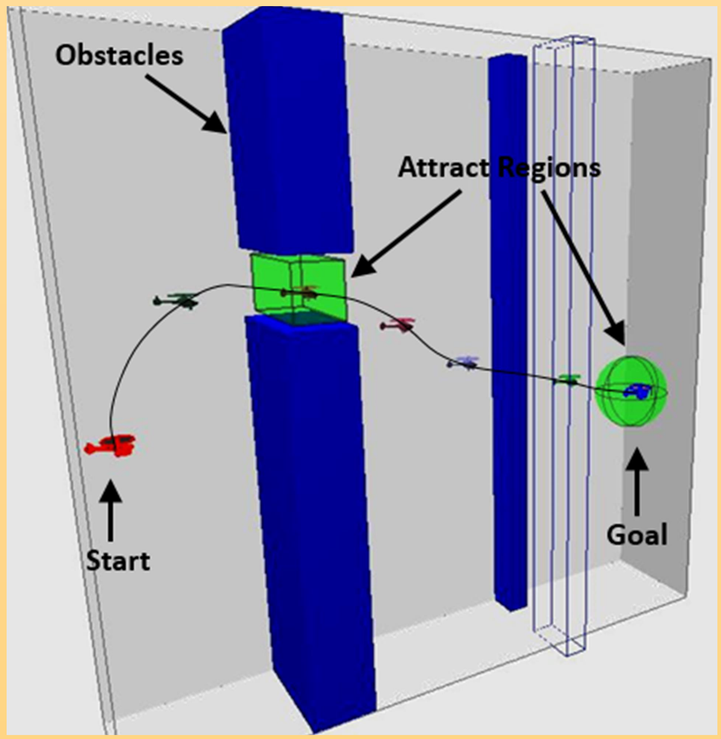


Kinodynamic Rapidly-exploring Random Trees (RRTs)

- Kinodynamic motion planners determine a sequence of controls to steer a robot under motion constraints
- RRTs iteratively grow a tree by selecting controls to steer toward random states until the goal is reached



Our Method



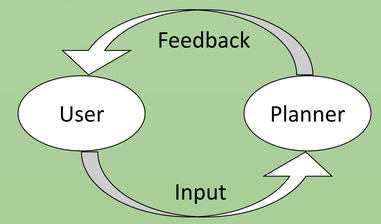
We introduce the first planner that allows Region Steering be applied to Kinodynamic problems. Our novel method, Kinodynamic Region RRT (KRRRT), combines human problem solving skills and KRRT's computational efficiency to optimize sampling speed.

Human-Guided Planning

- Combines human intuition and planner's precision
- Beneficial in difficult planning problems
- Human interacts with planner in virtual representation of the environment

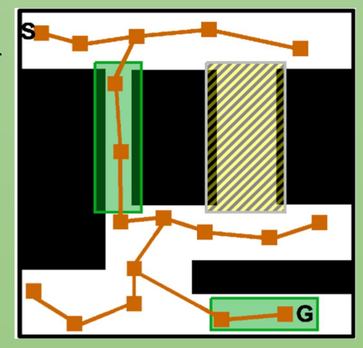
Collaborative Planning

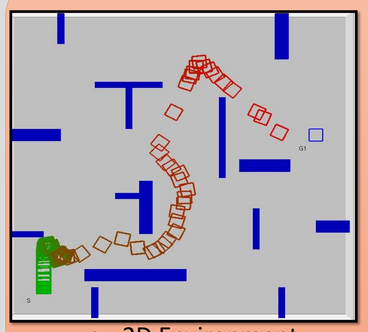
- The user and planner interact continuously throughout the planning process
- Designing meaningful input and feedback is challenging



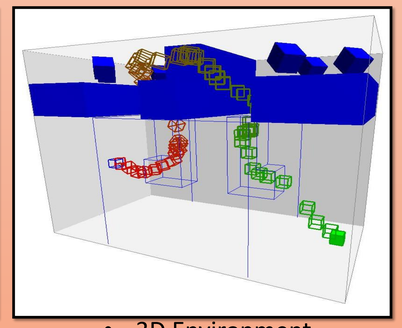
Region Steering

- Allows user to specify workspace regions that bias or repel sampling
- Applied to holonomic robots only
- Hasn't been applied to single query methods





- 2D Environment
- 6D State-space
- 4 Controls

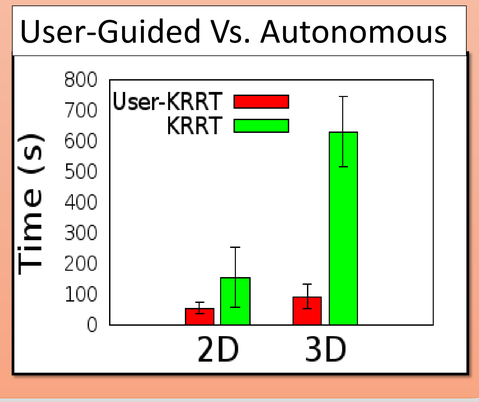


- 3D Environment
- 12D State-space
- 12 Controls

Results

- We compared our planner with KRRT in two difficult environments
- Measured total time (user+planner) averaged over ten trials

- **Our planner solved 100% of the time**, automated planner solved 30% of the time
- Our planner solved up to **six times faster**



Conclusion

Our combination of KRRT and Region steering, had a dramatic decrease in computational time compared to KRRT. We demonstrated that it is possible to guide a high-dimensional, non-holonomic problem with a low dimensional input.

Acknowledgements
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