# Anytime RRBT for Handling Uncertainty and Dynamic Objects

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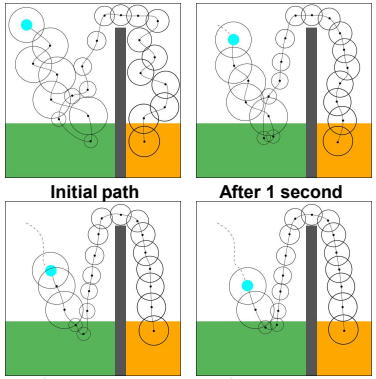
## Abstract

We present an efficient anytime motion planner for mobile robots that considers both other dynamic obstacles and uncertainty. Our planning algorithm maintains the best possible path throughout the robot execution, and the generated path gets closer to the optimal one as more computation resources are allocated. As a result, we achieve up to five times faster performance given a fixed path cost.

## Main Contribution

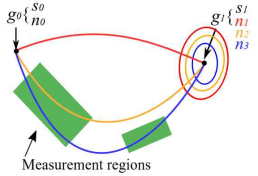
- Anytime RRBT method that considers uncertainty and generates collision-free paths, which are constantly improved toward the optimal one during execution.




Runtime results of our anytime RRBT method

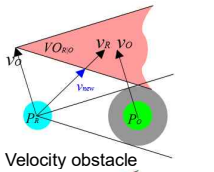
## Approaches

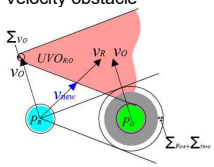
- **Rapidly-exploring Random Belief Tree**
  - A sampling based motion planning algorithm that taking the uncertainty into consideration
  - Generate an excessive amount of belief nodes considering different paths and uncertainty levels.



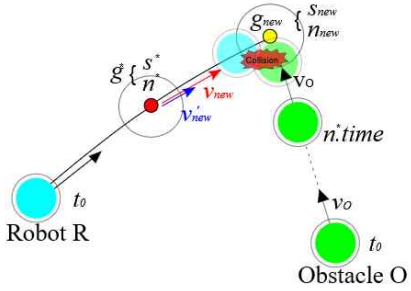

Rapidly-exploring Random Belief Tree

- **Anytime Extension**
  - Graph re-initializing method for making the RRBT reusable
  - Branch-and-bound method for accelerating the estimation process
- **Uncertainty-Aware Velocity Obstacle**
  - Simple local analysis and compute a velocity for a robot avoiding collisions against other dynamic objects



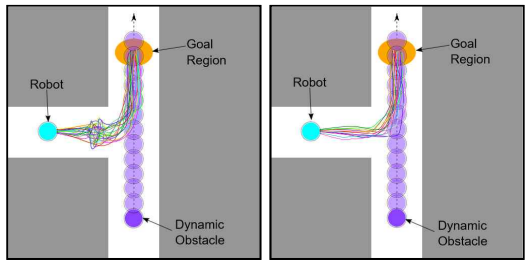
Uncertainty-aware velocity obstacle



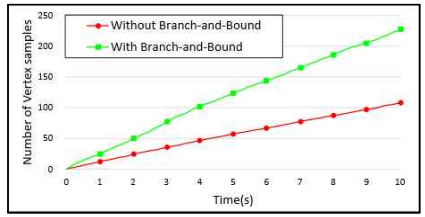

We use our UVO to check collision and compute a new velocity $v'_{new}$

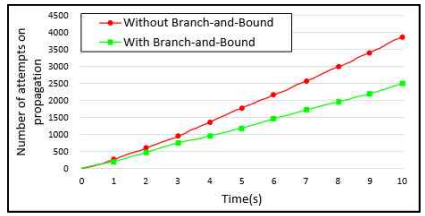
## Results

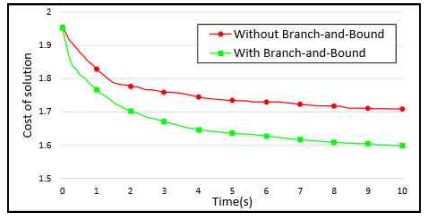
Video Demonstration




Trajectories tend to be more smooth and shorter than those generated by our method w/o UVO




Branch-and-Bound (BB) method accelerates our anytime RRBT method

Source Code: https://sglab.kaist.ac.kr/projects/anytimeRRBT