Robot Chase

Mobile Robot Systems final project

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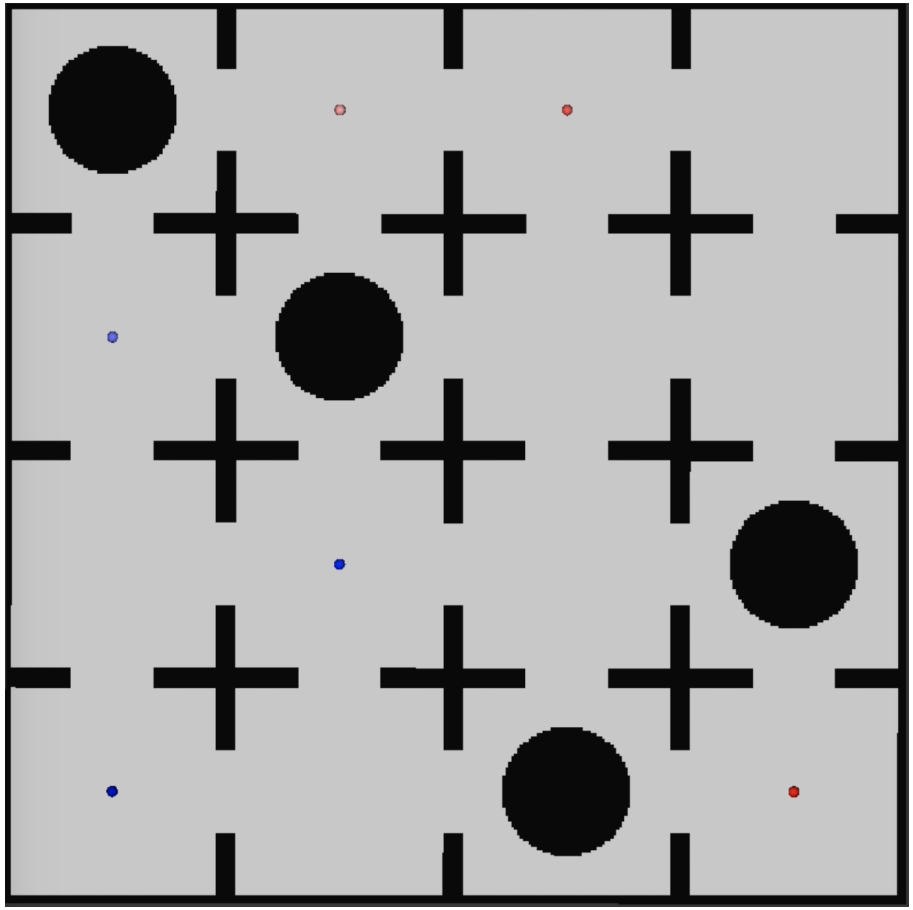
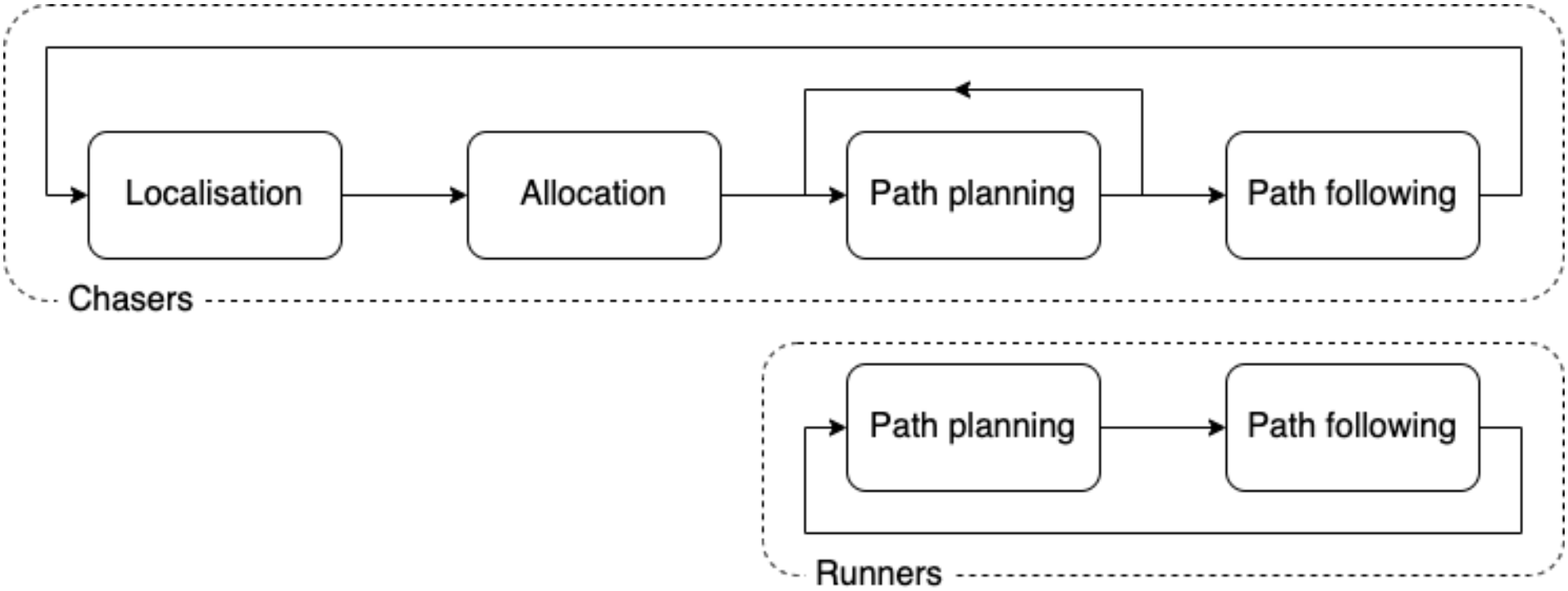
Problem definition

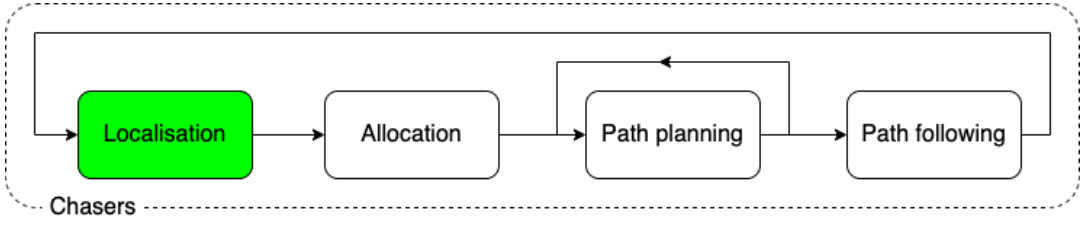
- Two teams of Turtlebots — chasers and runners.
- Chasers do not know runner positions.
- Chasers may communicate, runners cannot.
- Runners faster than chasers.
- Self-position and global environment known to all.



High-level workflow

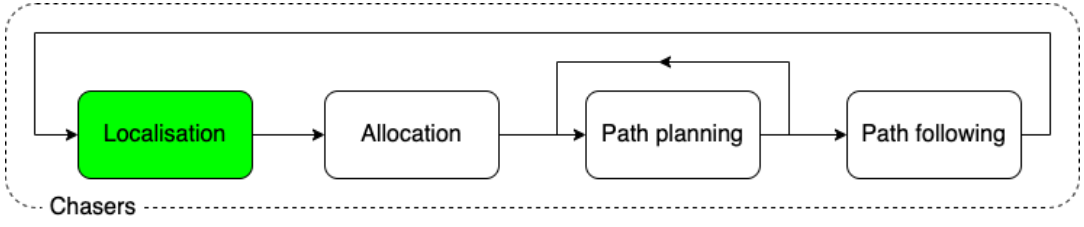


Localisation

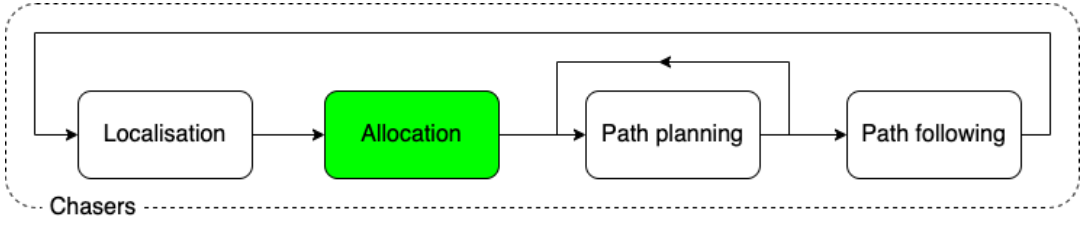


- Chasers must locate runners when out of line-of-sight.
- Chasers communicate runner observations.
- Build discrete approximation of Bayes Filter with particle cloud.

Localisation

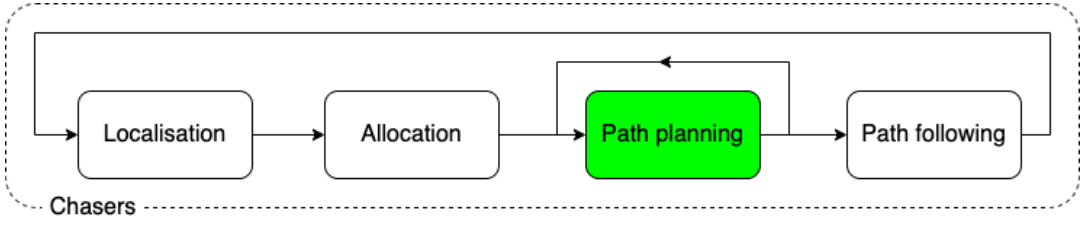


Chaser allocation



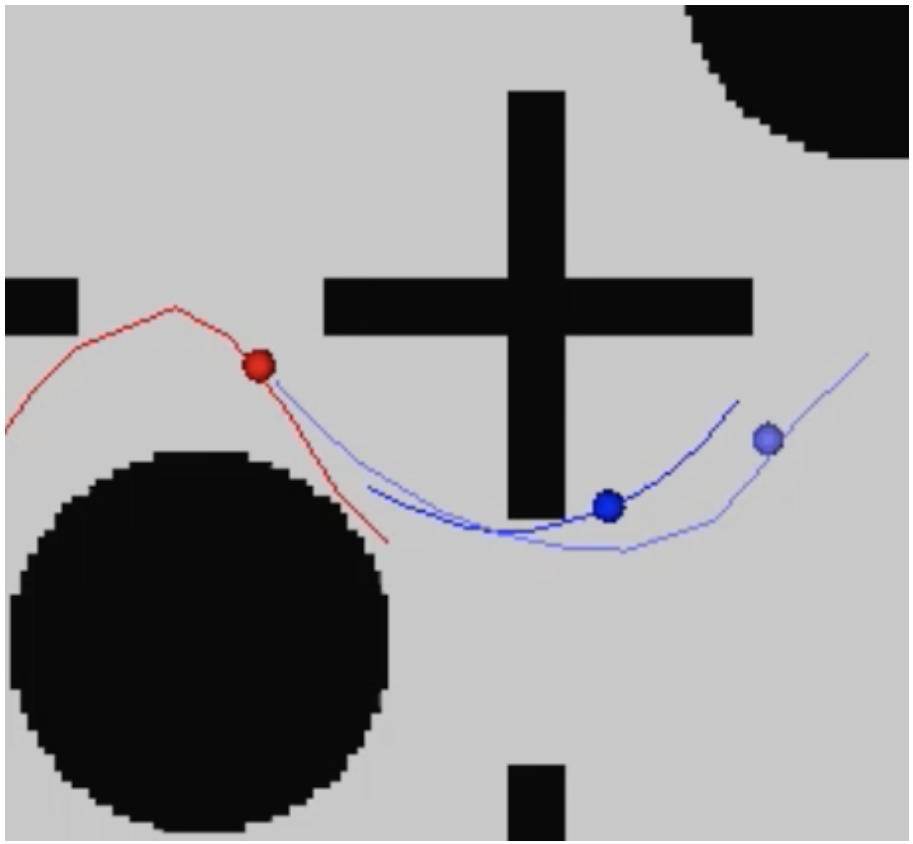
- Runners have speed advantage — chasers cannot catch alone.
- Allocate multiple chasers to each runner.
- Minimise chaser-runner distance in allocation.

Chaser path planning

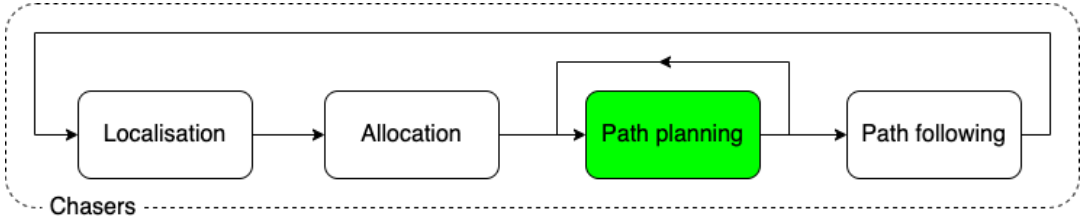


Problem:

- Chaser paths converge when allocated to same runner.
- May collide or act as a single chaser.

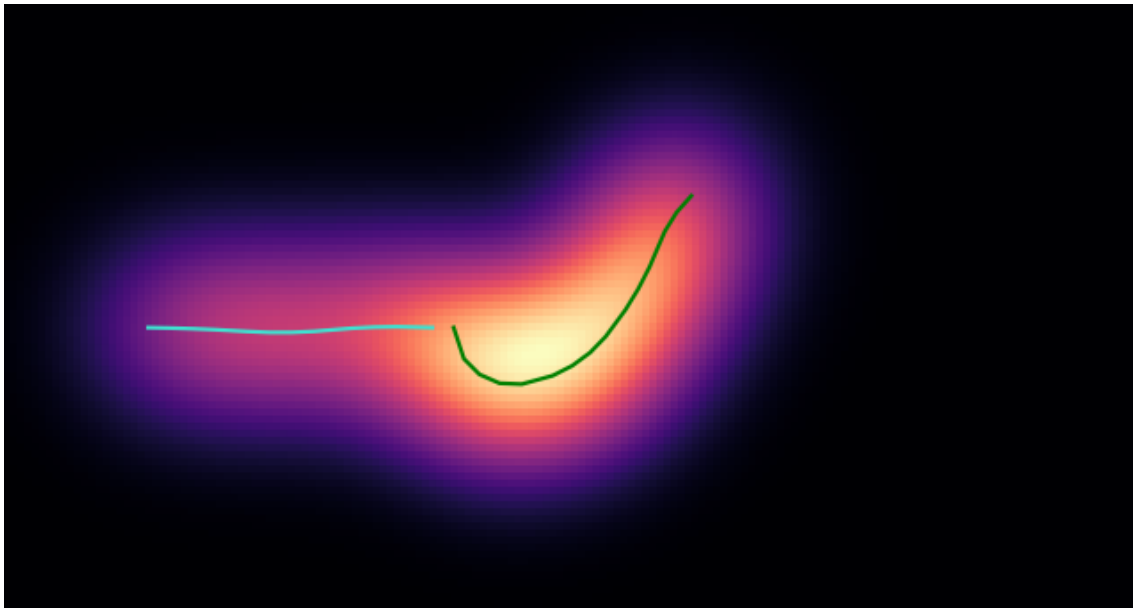


Chaser path planning

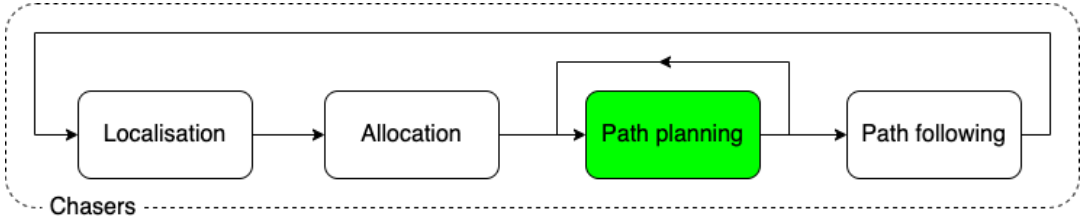


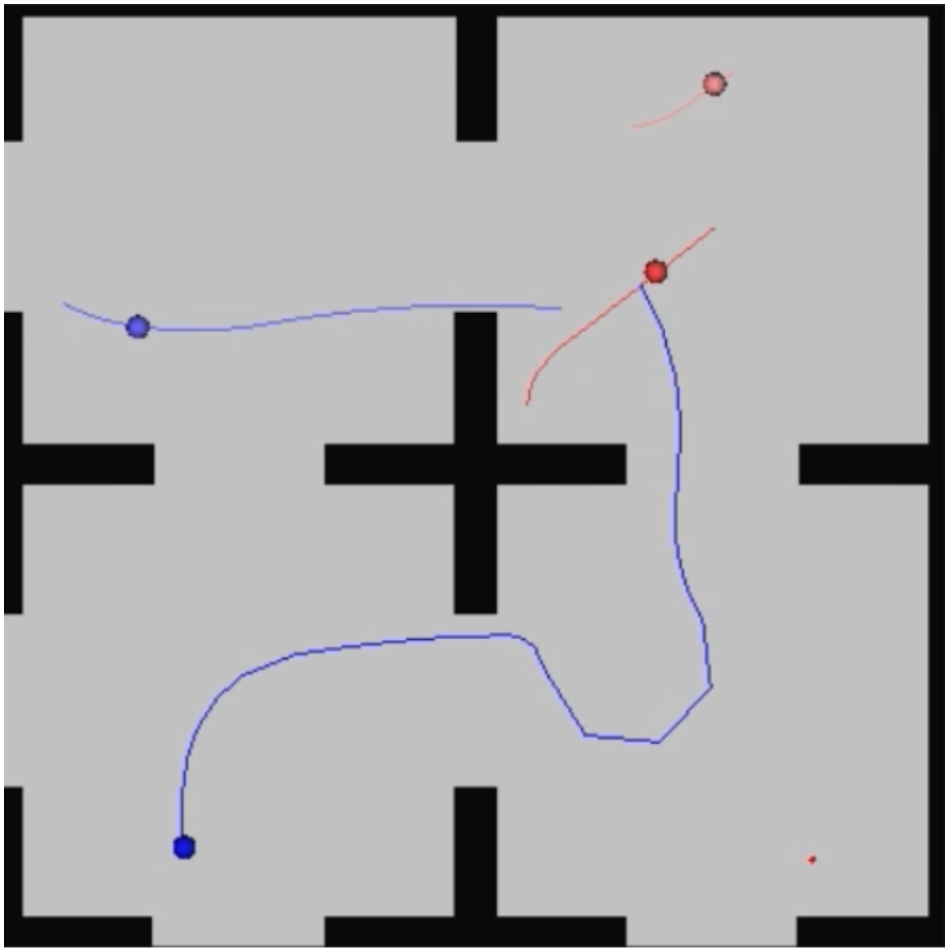
Solution:

- Perform **decoupled, prioritised** path planning.
  - Path generation — RRT*
  - Path evaluation — Potential field (using other paths)
  - Prioritisation heuristic — Runner-chaser distance

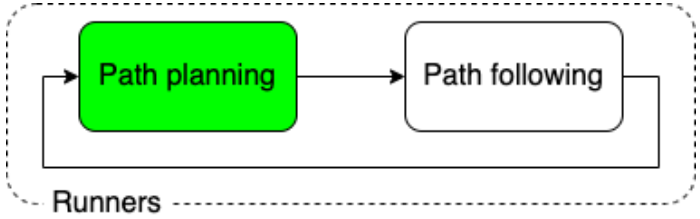


Chaser path planning



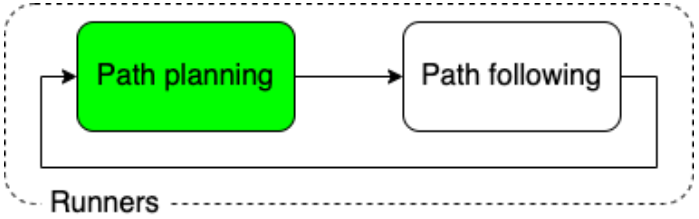


Runner path planning



- RTT* executed as with chaser.
- Potential field measures runner danger from:
  - Walls,
  - Other runners,
  - Chasers.
- Run for fixed iterations.

Runner path planning



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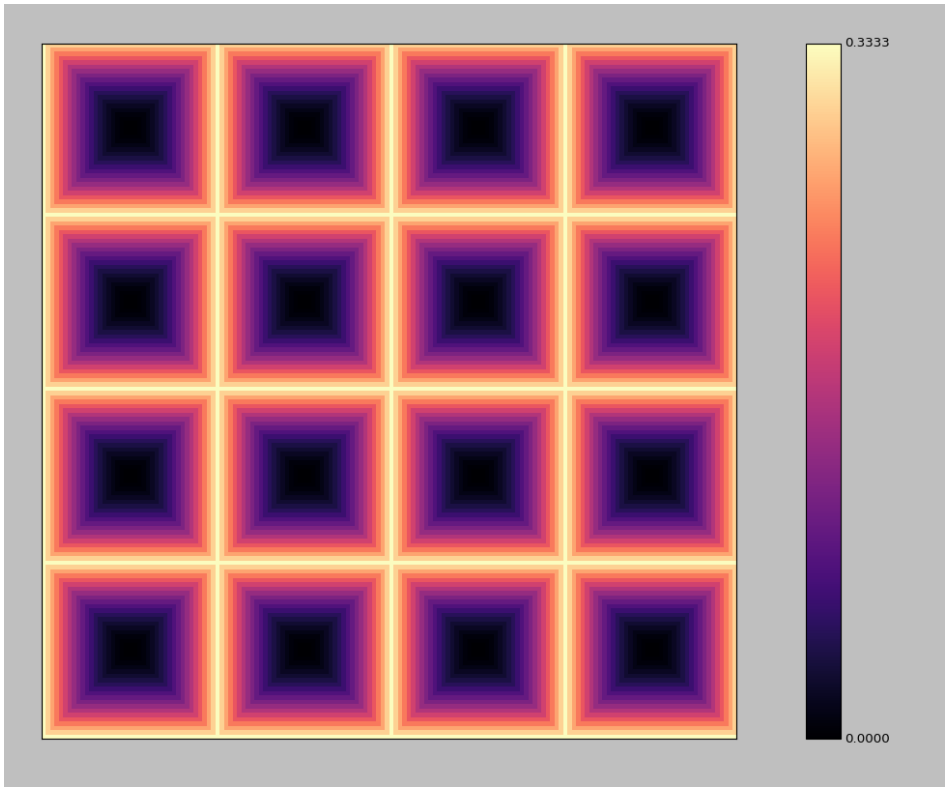

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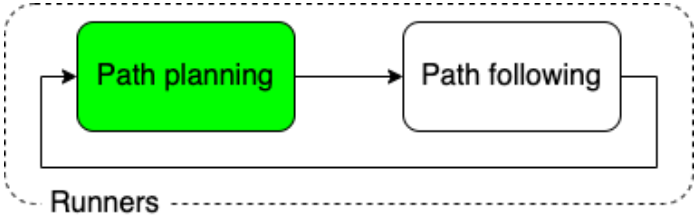

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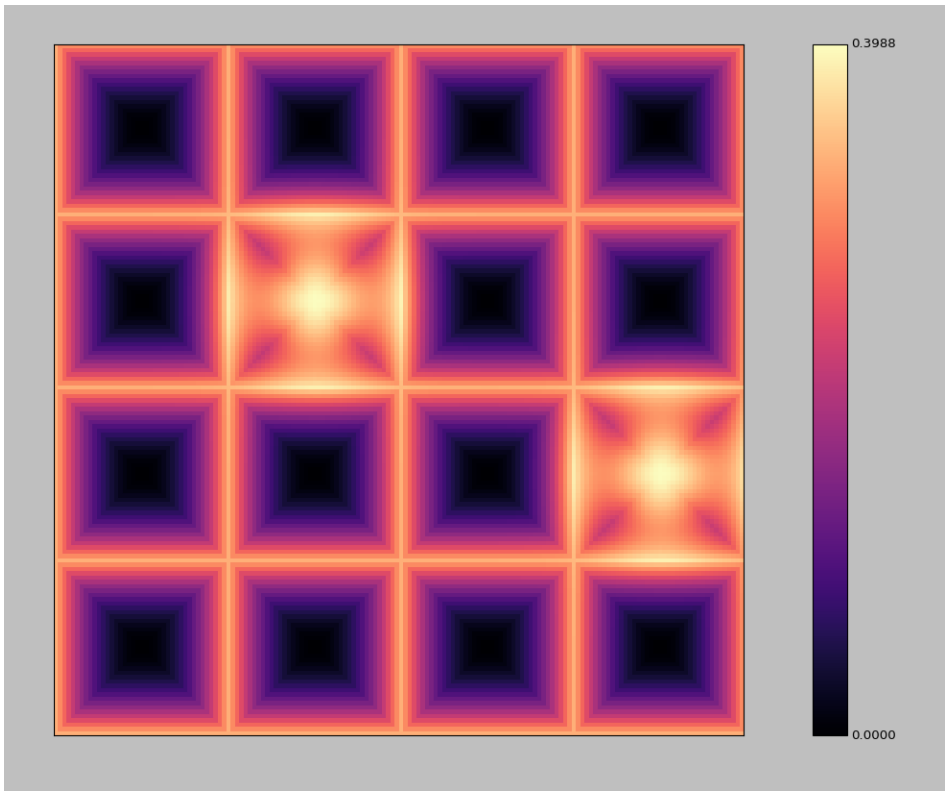

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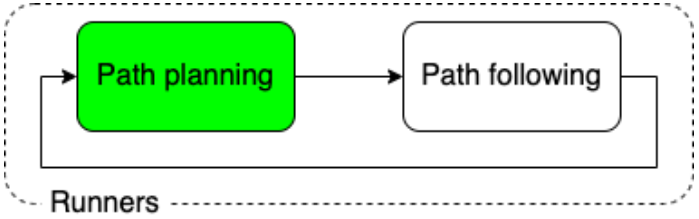

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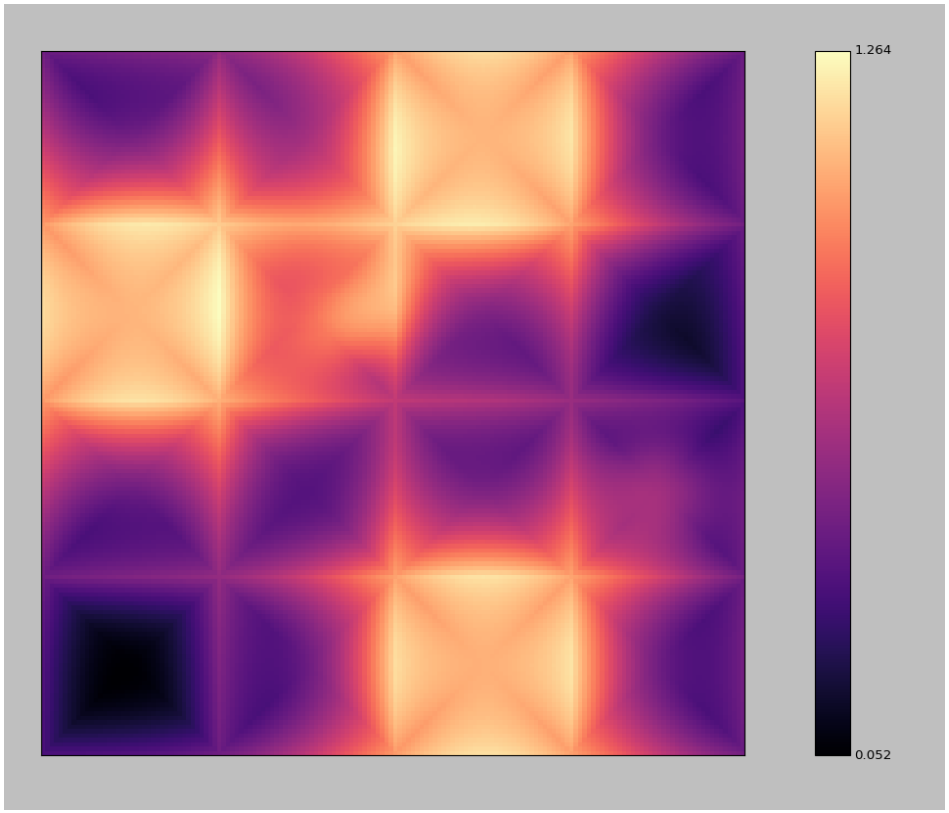
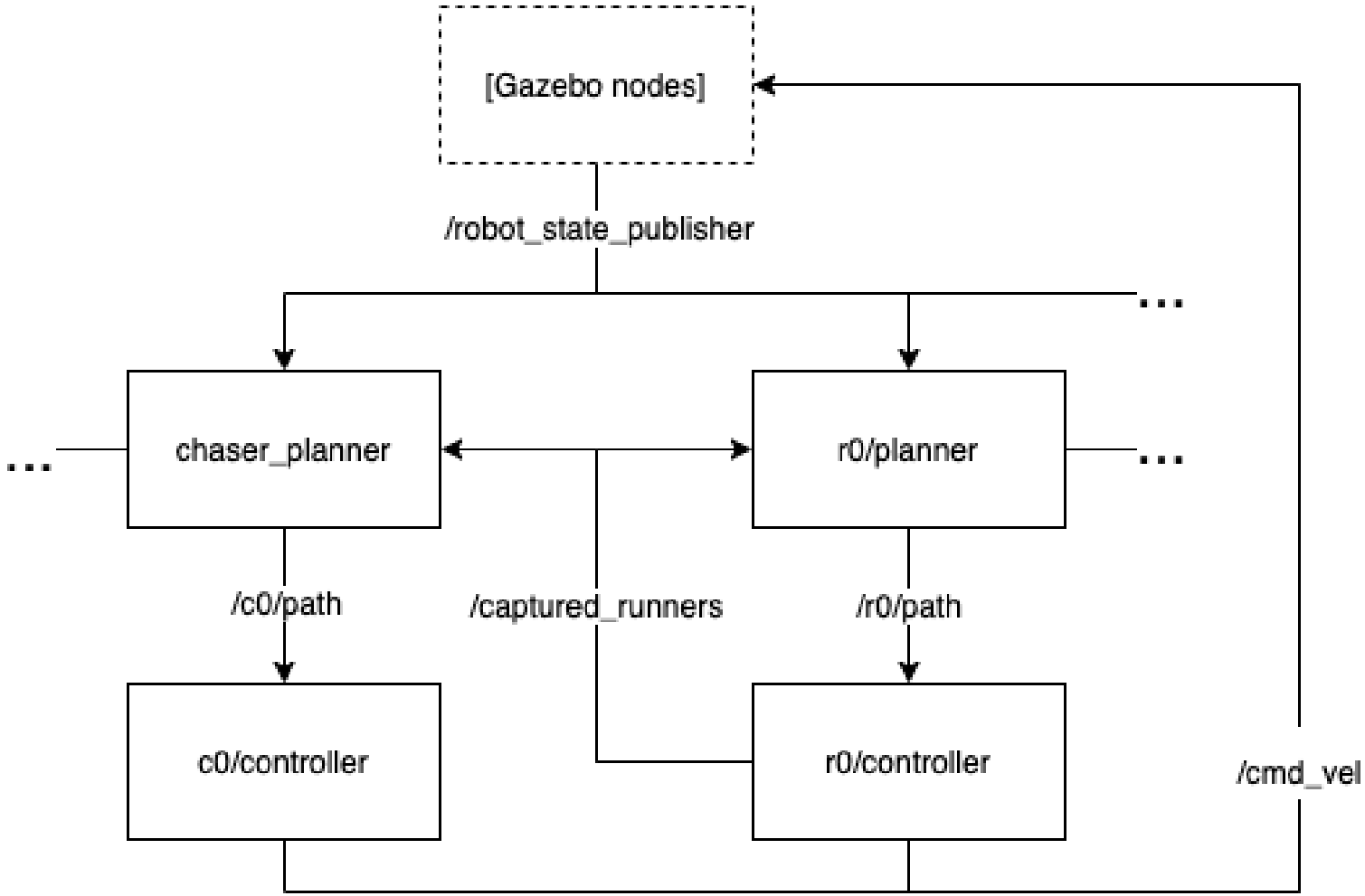


Implementation — ROS architecture



Implementation — RRT acceleration

- Random sampling:
  - Close to direct path.
  - On tree frontier.
- Limit sample density within region.