

## RRT-Rope

A deterministic shortening approach for fast near-optimal path planning  
in large-scale uncluttered 3D environments

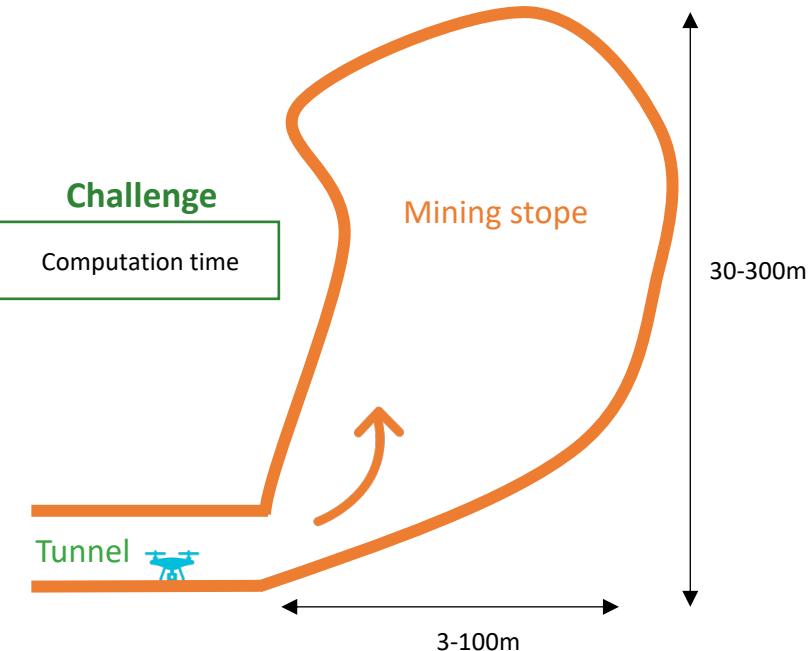
Presented by



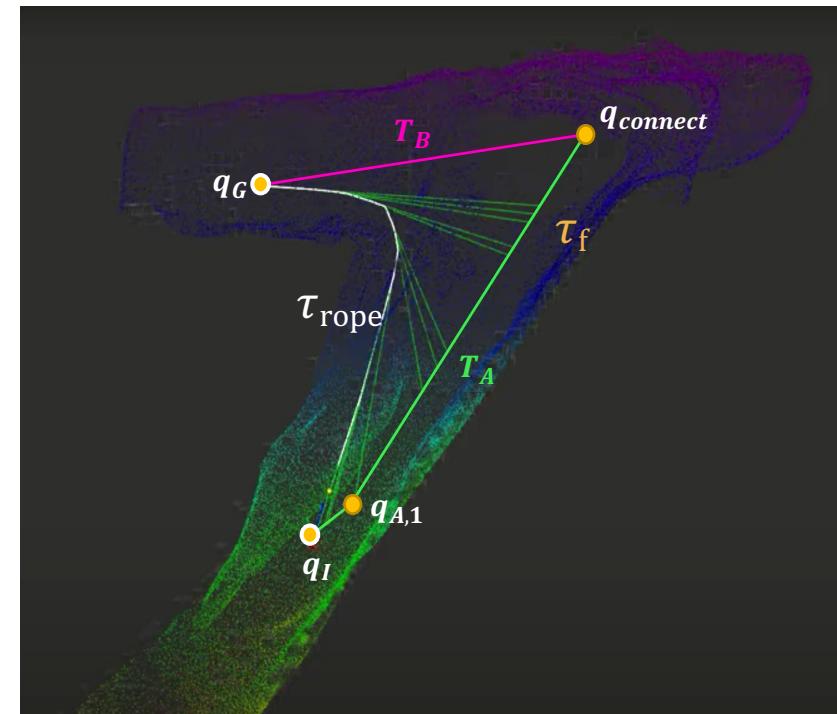
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**Mine mapping UAV****Popular shortening algorithms**

- Node pruning [1]
  - ✗ Loss of resolution
  
- Elastic strips [2]
  - ✗ Convergence time (online control)
  
- Partial-shortcut [3]
  - ✗ Irrelevant shortcuts
  - ✗ Non-deterministic

**RRT-Rope**

- Holonomic problem
- 3-ball homotopic environments

[1] Nasir, J., Islam, F., Malik, U., Ayaz, Y., Hasan, O., Khan, M., and Muhammad, M. S., "RRT\*-SMART: A Rapid Convergence Implementation of RRT\*," International Journal of Advanced Robotic Systems, 2013.

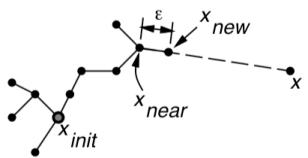
[2] Quinlan, S. and Khatib, O., "Elastic bands: connecting path planning and control," Proceedings IEEE International Conference on Robotics and Automation, pp. 802-807 vol.2, 1994.

[3] Geraerts, R. and Overmars, M.H., "Clearance based path optimization for motion planning," IEEE International Conference on Robotics and Automation, 2004. Proceedings. ICRA '04. 2004, pp. 2386-2392, vol.3, 2004.

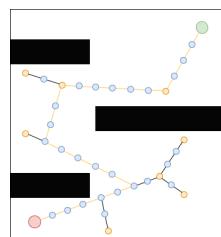
# Algorithm

## RRT-Rope

- ✓ Fast time for a feasible path
  - RRT-connect
  - Altered version without  $\epsilon$

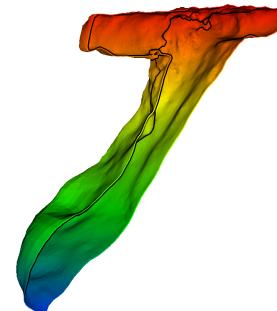
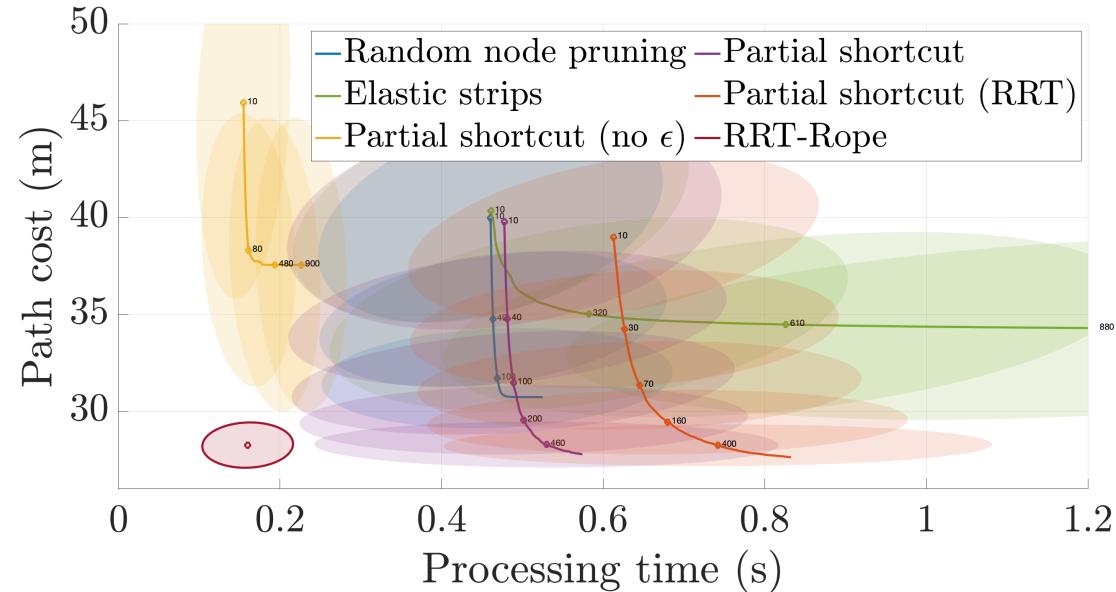


- ✓ Uniform resolution and near-optimality
  - Intermediate nodes insertion



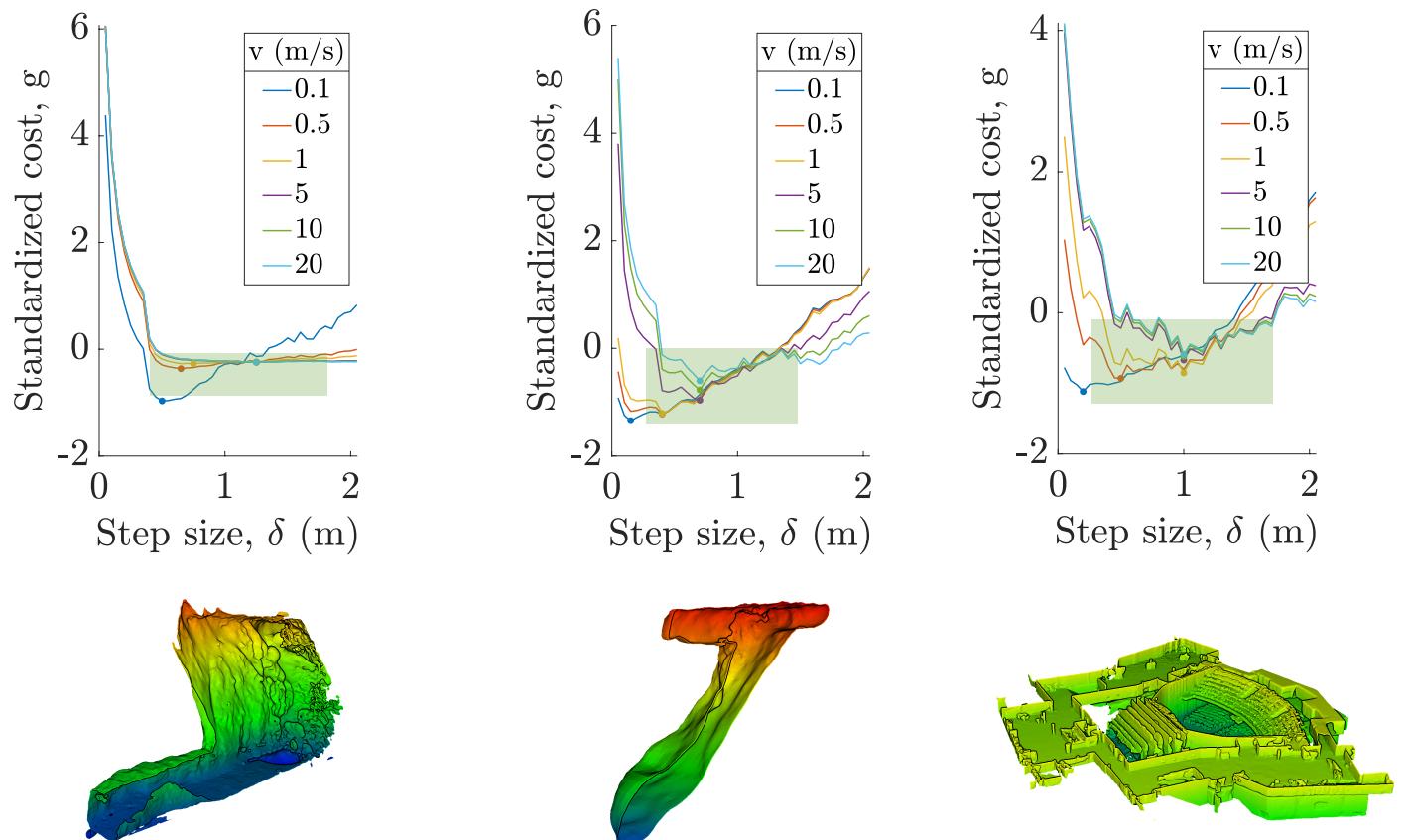
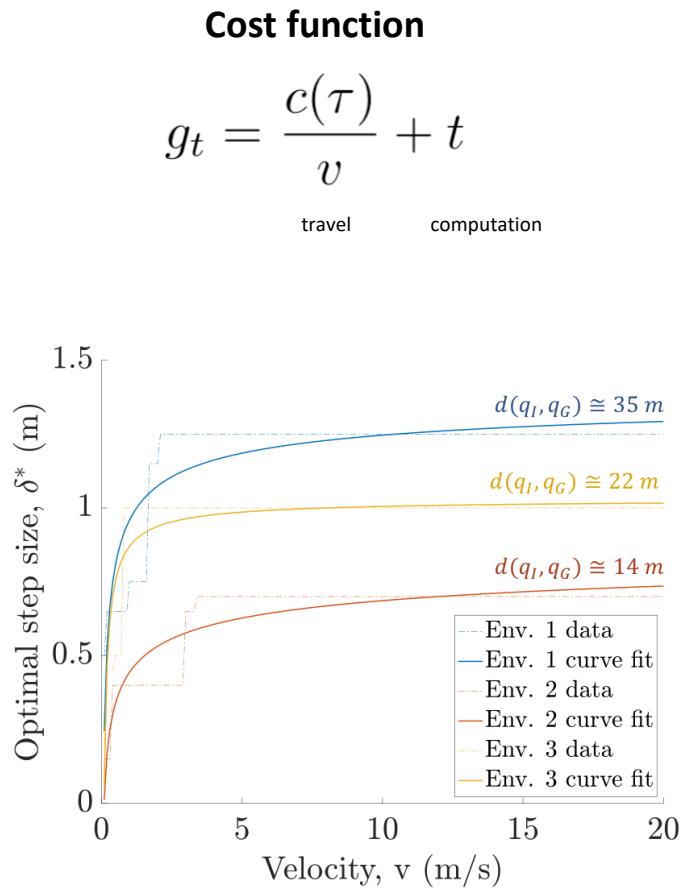
- ✓ Irrelevant shortcuts avoided (deterministic node selection)
  - Farthest nodes first
  - Straight line detection

- Equal or shorter path than state of the art in shorter computation time



# Analysis

## Step size sensitivity



- Fast UAV  $\rightarrow$  Bigger  $\delta$
- Long path  $\rightarrow$  Bigger  $\delta$
- Flat curve  $\rightarrow \delta \approx 0.8\text{ m}$