RRT-Rope

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

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Motivation

3D path planning in large uncluttered environments

Mine mapping UAV

- Holonomic problem
- 3-ball homotopic environments

Popular shortening algorithms

- Node pruning [1]
  - X Loss of resolution

- Elastic strips [2]
  - X Convergence time (online control)

- Partial-shortcut [3]
  - X Irrelevant shortcuts
  - X Non-deterministic

RRT-Rope

- Challenge
  - Computation time

- Tunnel

Tunnel Challenge

Computation time

30-300m

3-100m


**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
**Cost function**

\[ g_t = \frac{c(\tau)}{v} + t \]

**Analysis**

- **Step size sensitivity**

- **Cost function computation**

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<th>Travel</th>
<th>Computation</th>
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- Fast UAV → Bigger \( \delta \)
- Long path → Bigger \( \delta \)
- Flat curve → \( \delta \approx 0.8 m \)