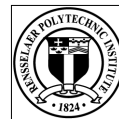


Path Planning on a Compressed Terrain

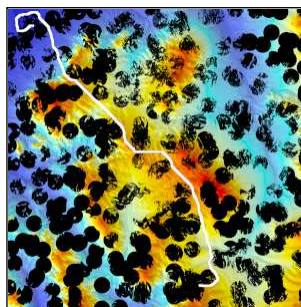
Daniel M. Tracy, W. Randolph Franklin,
Barbara Cutler, Franklin T. Luk,
Marcus Andrade, Metin Inanc, Zhongyi
Xie, Jared Stookey

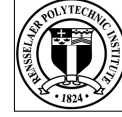
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Path Planning

- Smuggler's Path: Find the shortest path between two given points while trying to avoid detection by the observers.
- A* algorithm
- Add penalty for going uphill.





Cost Metric

- Cost of moving from one cell to an adjacent cell:

$$Cost = \sqrt{(h^2 + v^2)} \times SlopePenalty \times VisibilityPenalty$$

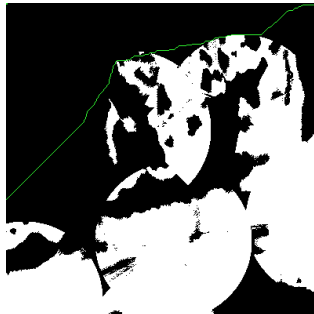
- h is the horizontal distance.
- v is the elevation difference.
- SlopePenalty is $1 + \frac{v}{h}$ when going uphill and 1 otherwise.
- VisibilityPenalty is 1 if the new cell is not visible and 100 otherwise.

3

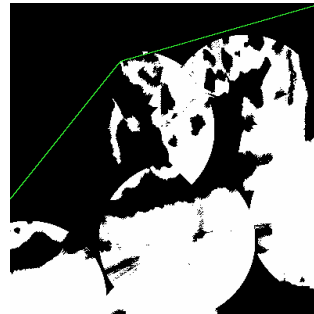


Range of Motion

Chebyshev



Euclidean

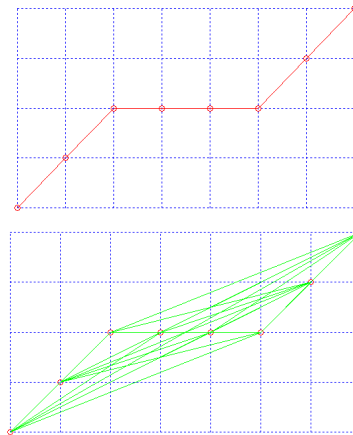


A straightforward application of the A* algorithm results in the Chebyshev distance being minimized, rather than the Euclidean distance.

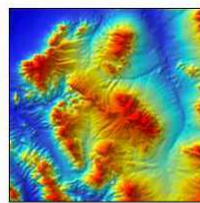
4

Path Planning

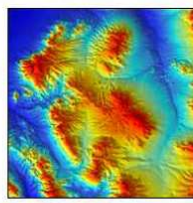
- New approach: Two pass system
- First pass: Plan a path that minimizes Chebyshev distance.
- Second pass: Only include points from the first path in the search space.
- Not guaranteed to be optimal, but in practice it often is.



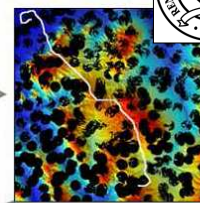
5



Original 3595x3595
W111N31 Terrain:
12,924,025 d.f., Elev
Range=2071

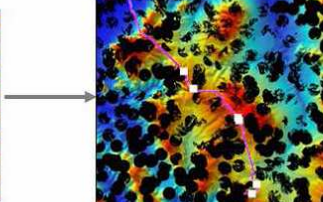
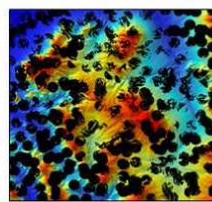


Compressed Terrain:
d.f. (16x reduction), Mean abs
error=1.7 (0.1%).



Compressed: Shortest
Smugglers Path Computed
Avoiding All 324 Viewsheds of
Optimally Sited Observers

Original: Joint
Viewshed
Computed for
Same 324
Observers



Evaluation: Optimal
Path from
Compressed Terrain
Tested on Original
Terrain Viewsheds -
14 of 4767 Points
(0.3%) Are
Erroneously Visible

6

