Shortest descending paths on polyhedral terrain

[HTML] Approximation algorithms for shortest descending paths in terrains
M Ahmed, S Das, S Lodha, A Lubiw - ... of Discrete Algorithms, 2010 - Elsevier
From: http://scholar.google.ca/scholar?hl=en&q=Approximation+algorithms+for+shortest+descending+paths+in+terrains&btnG=&as_sdt=1%2C5&as_sdtp=

Shortest descending paths: Towards an exact algorithm
M Ahmed, A Lubiw - International Journal of Computational ... 2011 - World Scientific
From: http://scholar.google.ca/scholar?q=Shortest+descending+paths%3A+Towards+an+exact+algorithm&btnG=&hl=en&as_sdt=2005&sciodt=0%2C5&cites=15807659110083868733&scipsc=

in P or NP-hard? OPEN
Shortest descending paths on polyhedral terrain
Shortest descending paths on polyhedral terrain

unfold faces

shortest descending path is not straight in unfolding
Shortest descending paths on polyhedral terrain

locally shortest path structure

\[ s \]

- shortest path (straight)
- contour line path
Shortest descending paths on polyhedral terrain

locally shortest path structure

\[ m_i \sin a_i + l_{ij} = m_j \sin b_j \]

generalized Snell’s Law

the first direction choice determines a locally shortest path

can we use Chen and Han?
Recall Chen and Han, Shortest paths on polyhedron surface.

To expand past edge $e$, keep segments on $e$ reached by each "cone" from $s$.

How a cone expands into next triangle.

Keep track of segments and rays to endpoints.
Recall Chen and Han, Shortest paths on polyhedron surface.

expand all cones

trim using one-vertex one-cut
Shortest descending paths on polyhedral terrain

Can we use Chan and Han?

- trace a locally shortest path
- trim the tree (one-vertex one-split)
- find path to $v$ through unfolded face sequence

---

- Yes!
- True!

---

OPEN (to do this in poly. time)
Shortest descending paths on polyhedral terrain

positive results for related problems (weighted region): approximation algorithms

add many Steiner points, use graph shortest path

**Determining approximate shortest paths on weighted polyhedral surfaces**
From: [http://scholar.google.ca/scholar?q=Determining+approximate+shortest+paths+on+weighted+polyhedral+surfaces&btnG=&hl=en&as_sdt=0%2C5](http://scholar.google.ca/scholar?q=Determining+approximate+shortest+paths+on+weighted+polyhedral+surfaces&btnG=&hl=en&as_sdt=0%2C5)

**On finding approximate optimal paths in weighted regions**
Z Sun, JH Reif - Journal of Algorithms, 2006 - Elsevier
From: [http://scholar.google.ca/scholar?q=On+finding+approximate+optimal+paths+in+weighted+regions&btnG=&hl=en&as_sdt=0%2C5](http://scholar.google.ca/scholar?q=On+finding+approximate+optimal+paths+in+weighted+regions&btnG=&hl=en&as_sdt=0%2C5)
Shortest descending paths on polyhedral terrain

Approximation

when we add a Steiner point, add points on all edges at that height

place points uniformly on edges, or in geometric progression — run time will depend on geometric parameters
possible paper to present (mentioned earlier)

Approximate shortest descending paths
From: http://scholar.google.ca/scholar?q=Approximate+shortest+descending+paths&btnG=&hl=en&as_sdt=2005&sciodt=0%2C5&scipsc=