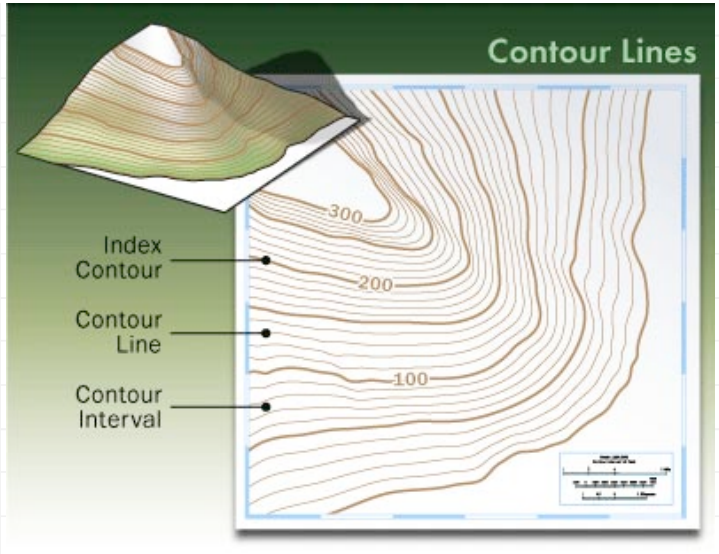
Shortest descending paths on polyhedral terrain

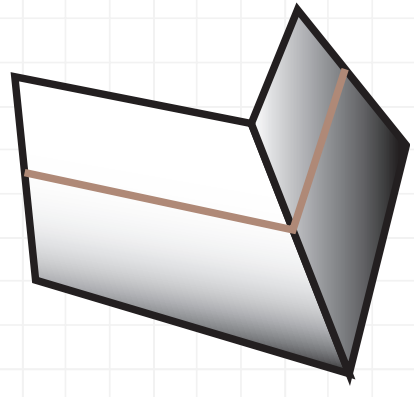
[HTML] **Approximation algorithms for shortest descending paths in terrains**
M Ahmed, S Das, S Lodha, A Lubiw… - … of Discrete **Algorithms**, 2010 - Elsevier
From: http://scholar.google.ca/scholar?hl=en&q=Approximation+algorithms+for+shortest+descending+paths+in+terrains&btnG=&as_sdt=1%2C5&as_sdtp=

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





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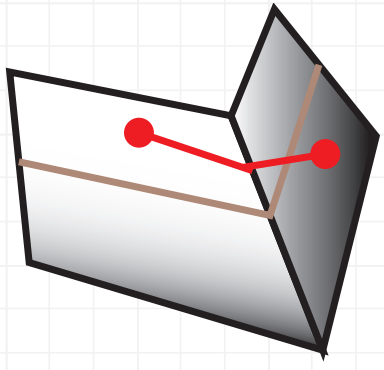
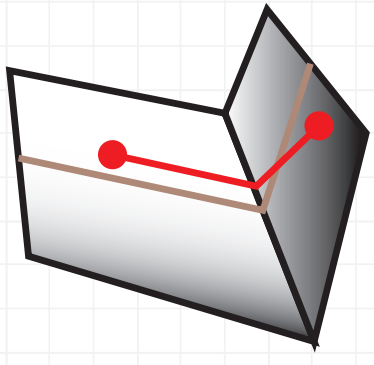
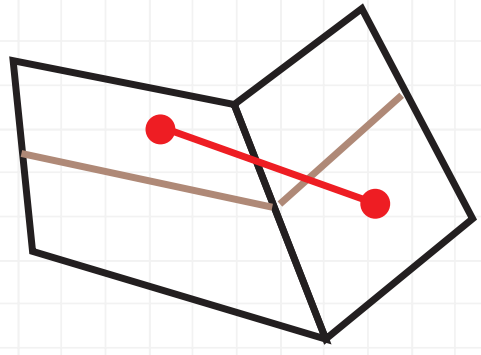
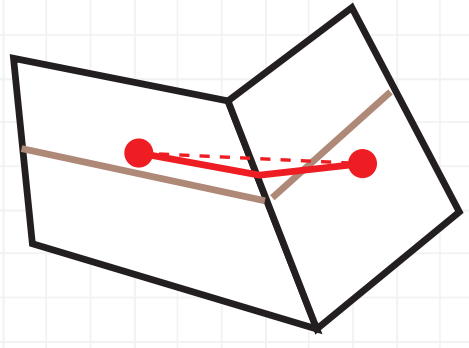




unfold faces

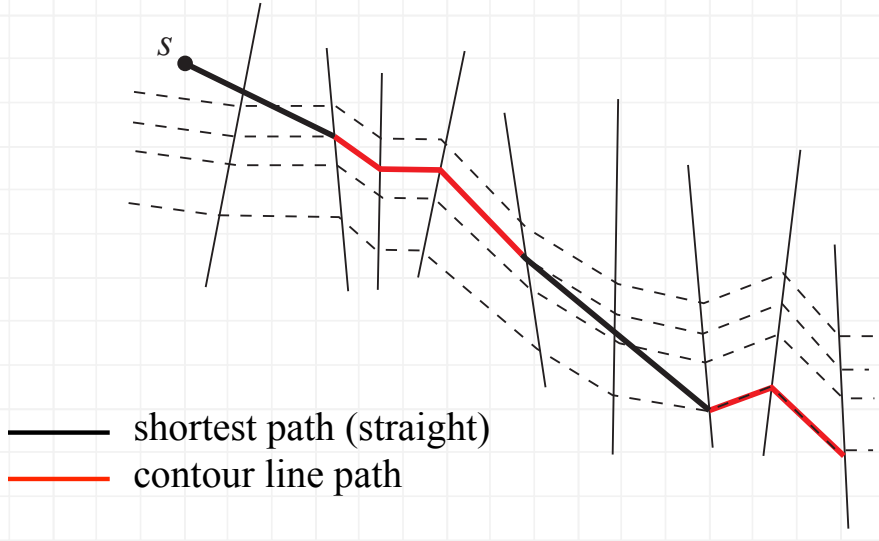




shortest descending path is
not straight in unfolding

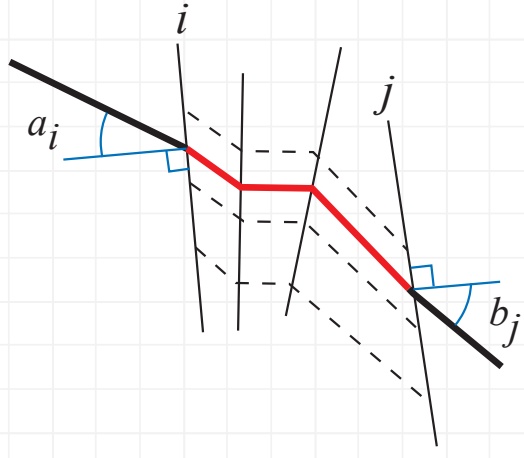
Shortest descending paths on polyhedral terrain

locally shortest path structure



Shortest descending paths on polyhedral terrain

locally shortest path structure



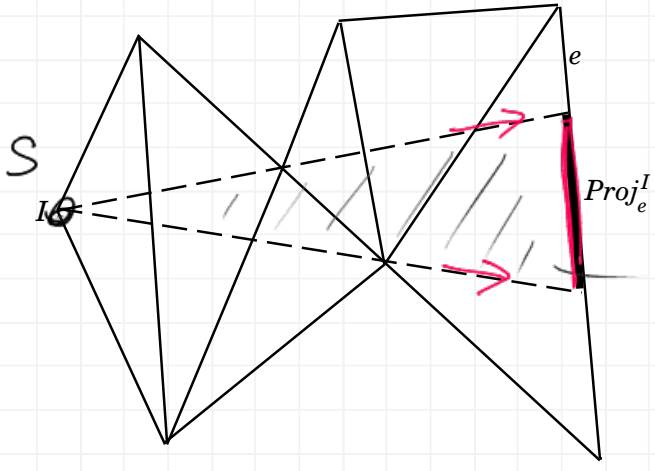
$$m_i \sin a_i + l_{ij} = m_j \sin b_j$$

generalized Snell's Law

the first direction choice determines a locally shortest path

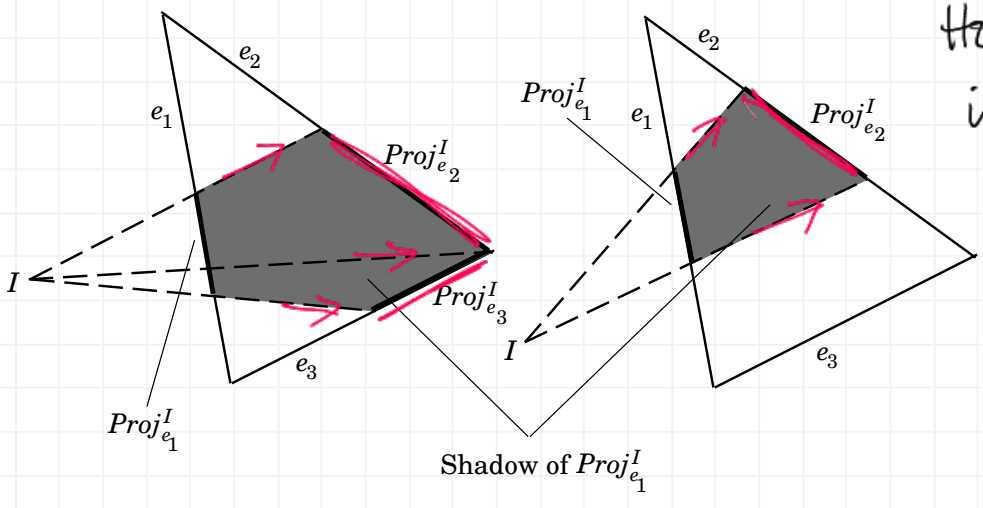
can we use Chen and Han?

Recall Chen and Han, Shortest paths on polyhedron surface.



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

cone

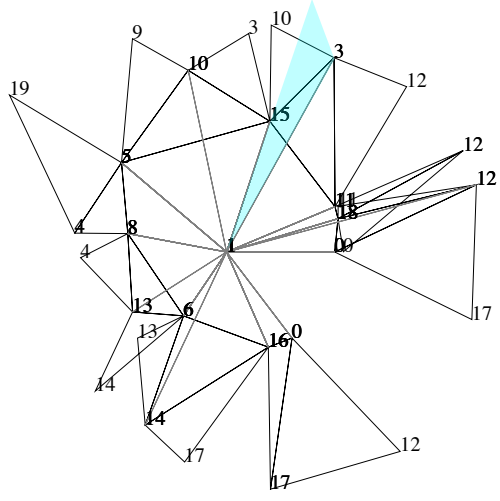


How a cone expands into next triangle

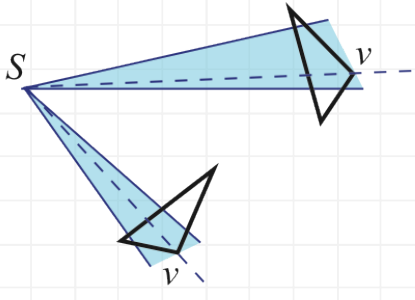
Keep track of segments and rays to endpoints

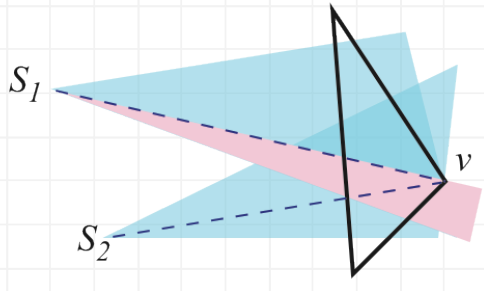
Recall Chen and Han, Shortest paths on polyhedron surface.

expand all cones



trim using one-vertex one-cut





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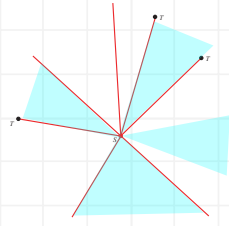
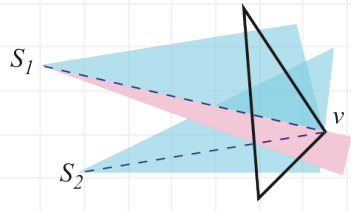
Can we use Chan and Han?



— Yes!

- trace a locally shortest path
- trim the tree (one-vertex one-split)



True!

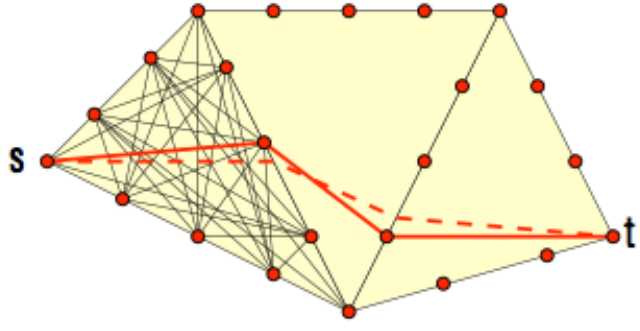
- find path to v through unfolded face sequence

— 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



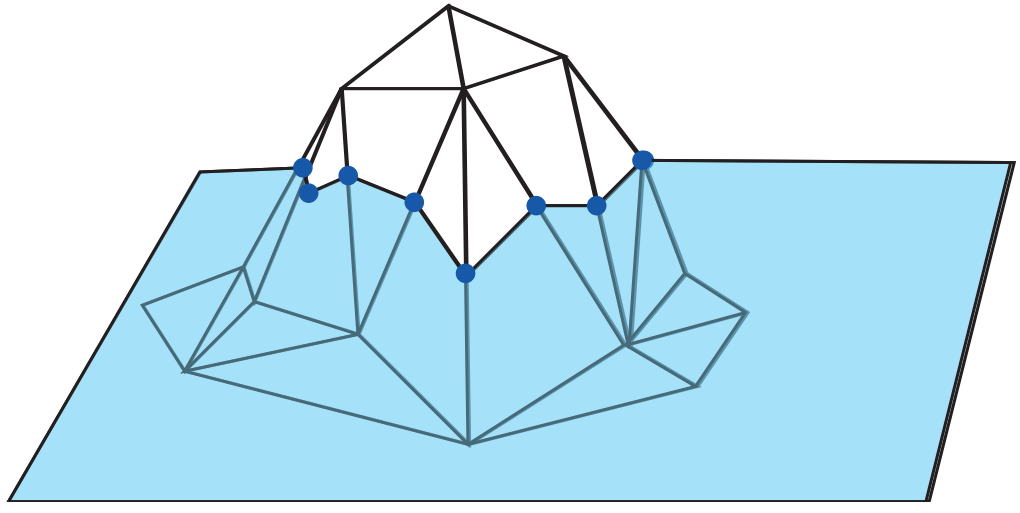
Determining approximate shortest paths on **weighted polyhedral surfaces**
L Aleksandrov, A Maheshwari, JR Sack - Journal of the ACM (JACM), 2005 - dl.acm.org
From: http://scholar.google.ca/scholar?q=Determining+approximate+shortest+paths+on+weighted+polyhedral+surfaces&btnG=&hl=en&as_sdt=0%2C5

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

} mentioned previously

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
SW Cheng, J Jin - SIAM Journal on Computing, 2014 - SIAM
From: http://scholar.google.ca/scholar?q=Approximate+shortest+descending+paths&btnG=&hl=en&as_sdt=2005&sciodt=0%2C5&cites=15807659110083868733&scipsc=