UNIVERSITY OF SALZBURG
Computational Geometry and Applications Lab

Straight Skeleton Implementations based on Exact Arithmetic

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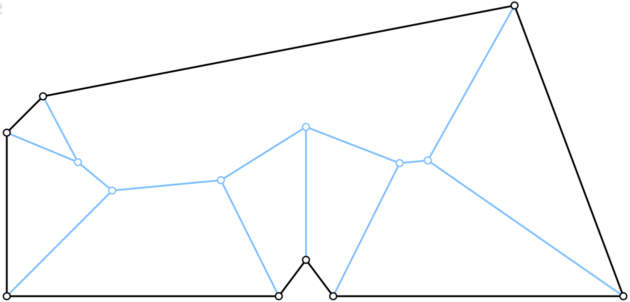
- Edge Events, Split Events.
- Applications: Tool path generation



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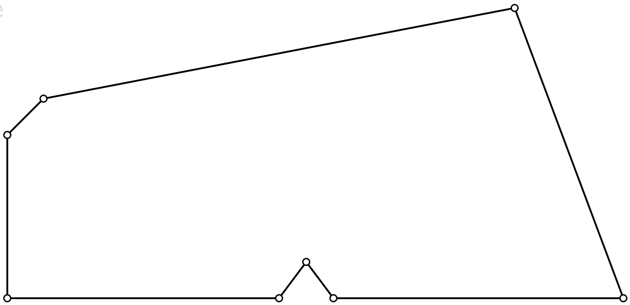

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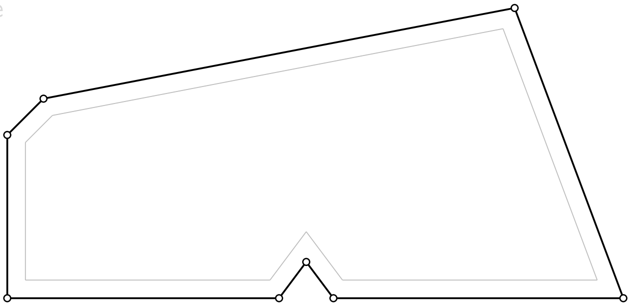

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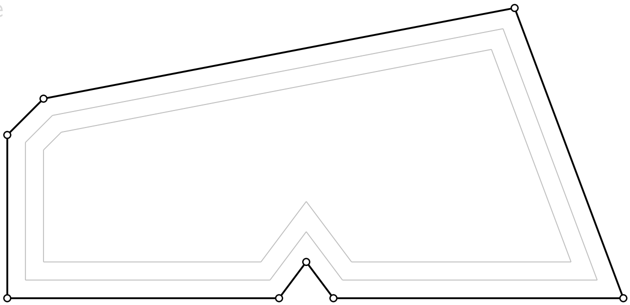

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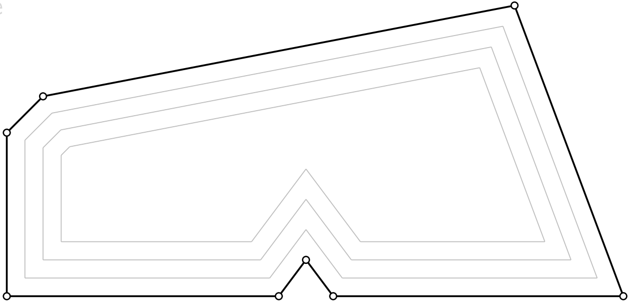

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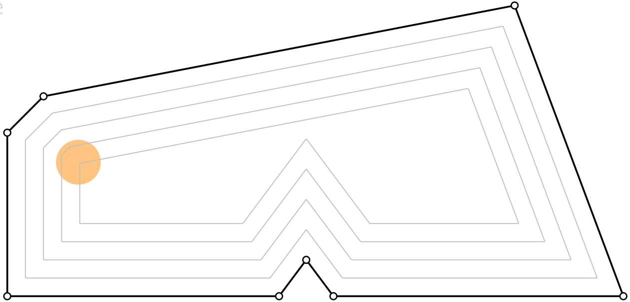

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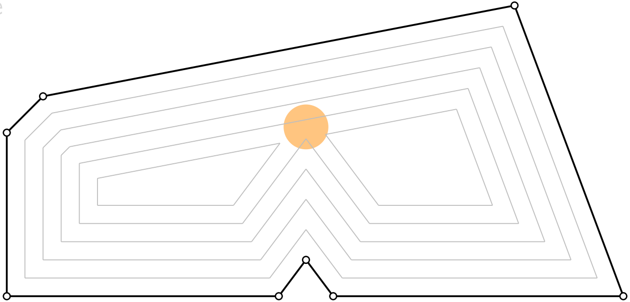

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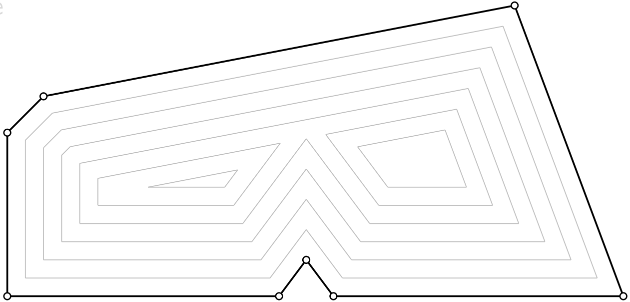

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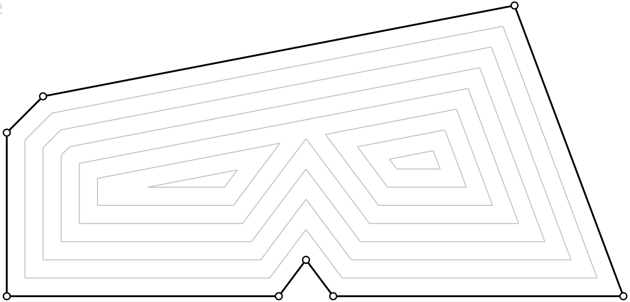

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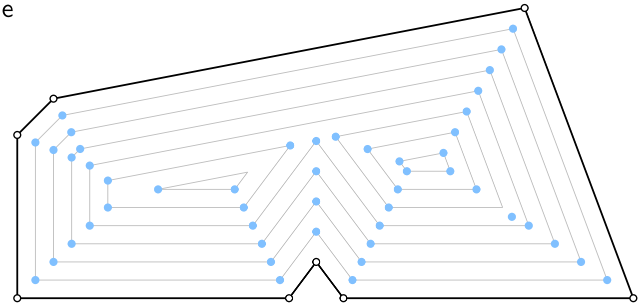

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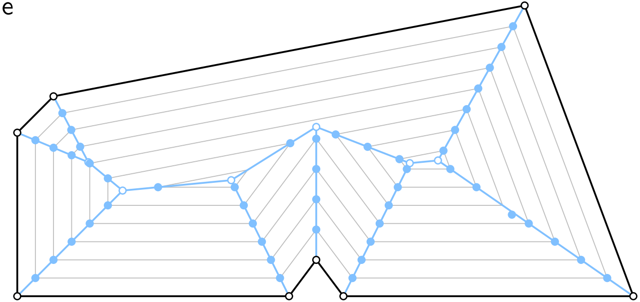

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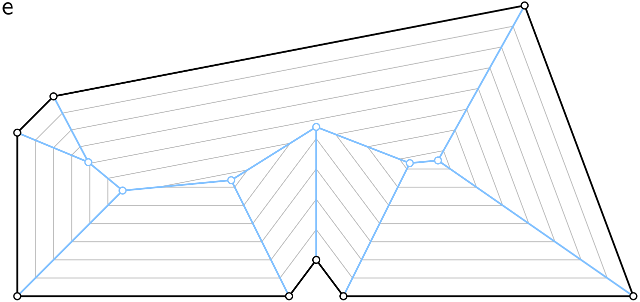

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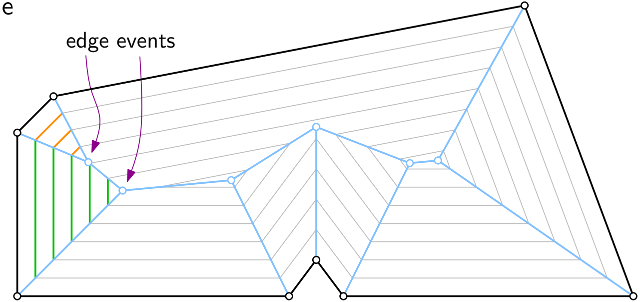

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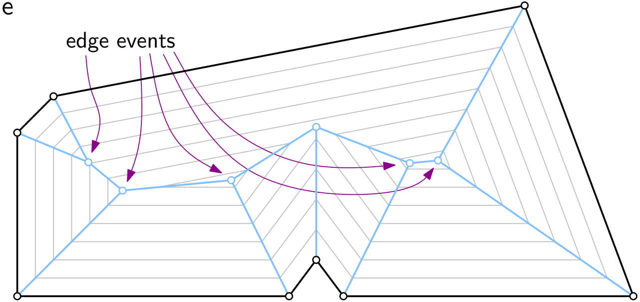

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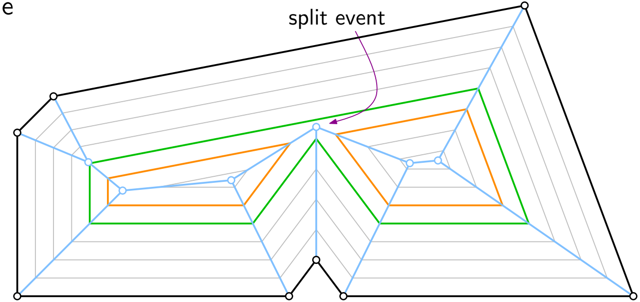

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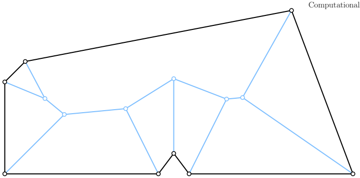

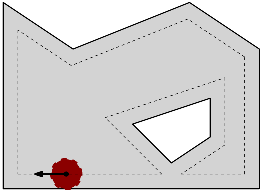

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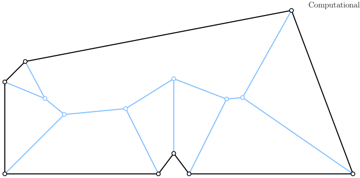

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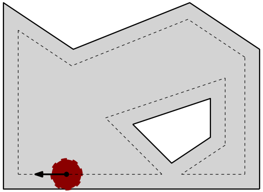

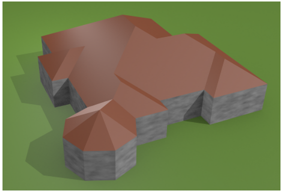

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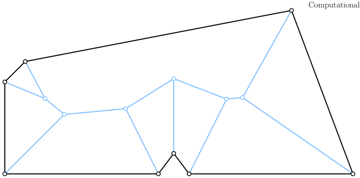

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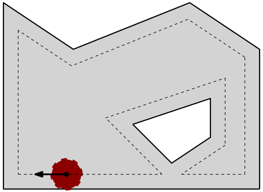

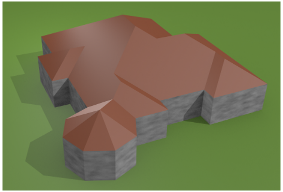

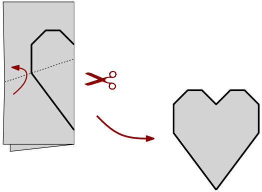

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Best worst-case complexity:

- Eppstein and Erickson (1998) and Cheng et al. (2016).

With implementations:

- Cacciola (2004), based on Felkel and Obdržálek (1998).
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- Part of CGAL.
- Input: polygons and polygons with holes.
- Priority queue of edge events and all *potential* split events.
- There are quadratic many such *potential* split events.

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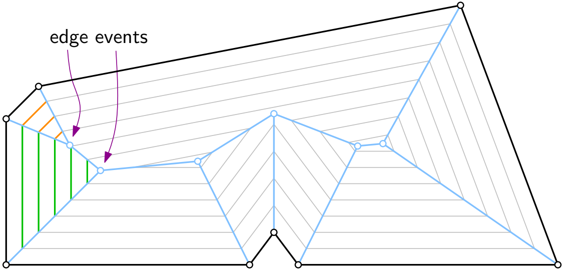

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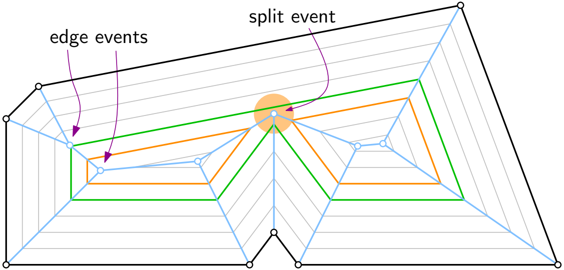

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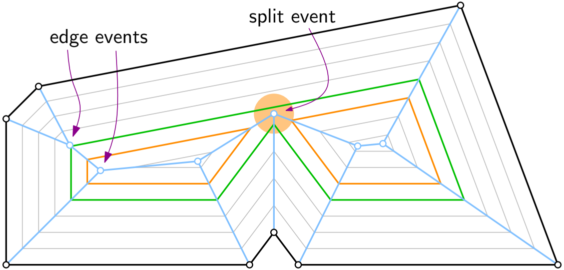

Biedl et al.

- Input: (strictly) monotone polygons.
- Key Observation: A monotone chain never splits.
- Idea: Compute the straight skeleton of two chains,
  then merge them.
- Runtime: $\mathcal{O}(n \log n)$.

- **New implementation:** Monos.
- Also works on *not-strictly* monotone polygons (tricky in the merge step).

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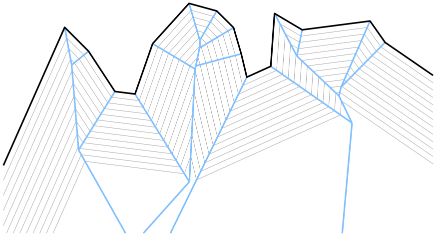

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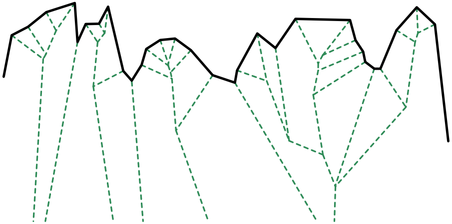

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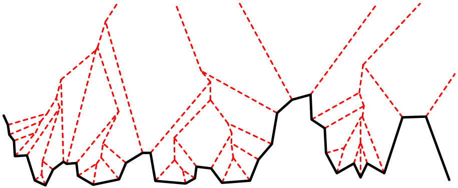

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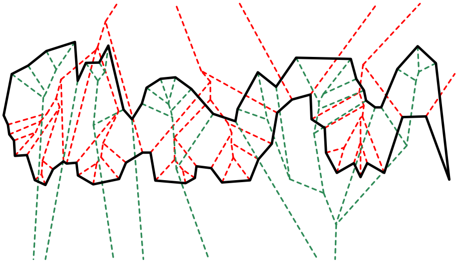

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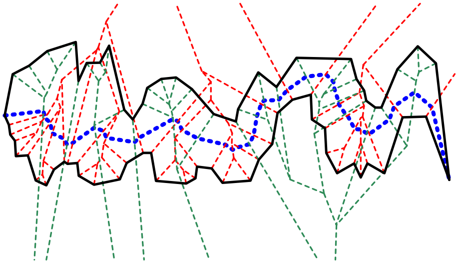

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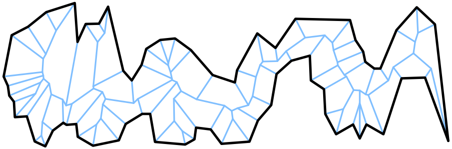

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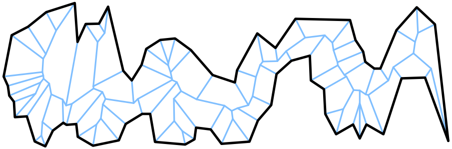

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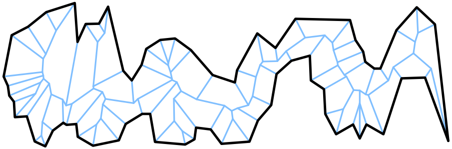

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- Input: PSLGs. Can compute the weighted straight skeleton.
- Uses a kinetic data structure to witness events:
  Triangulate the not-yet-swept plane; triangles witness events.
- There are only linear many *real events*.
  However, there might be $O(n^3)$ flip events.

- **New implementation:** SURFER2.
- Several special cases not considered in the original paper.

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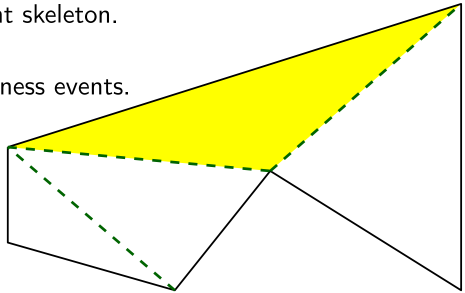

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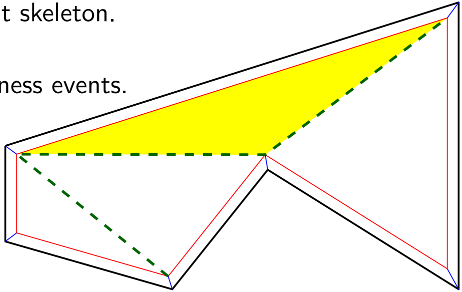

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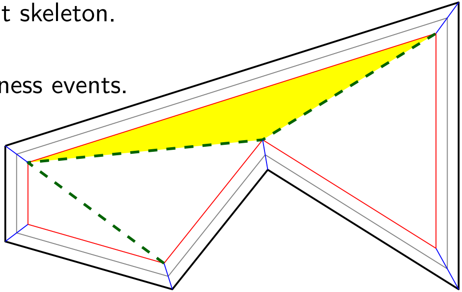

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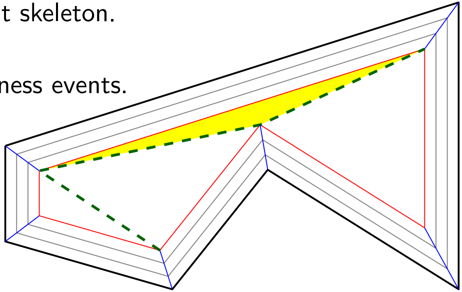

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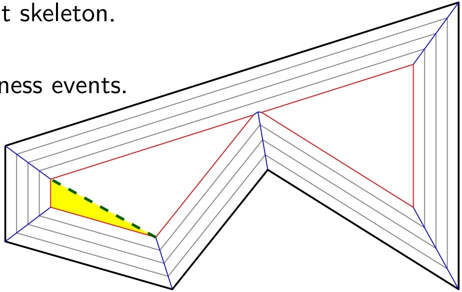

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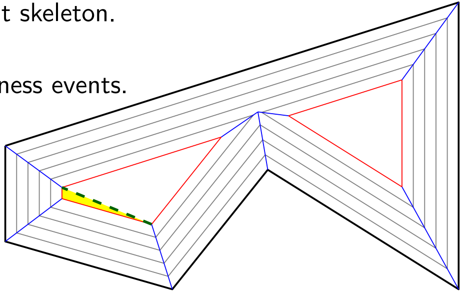

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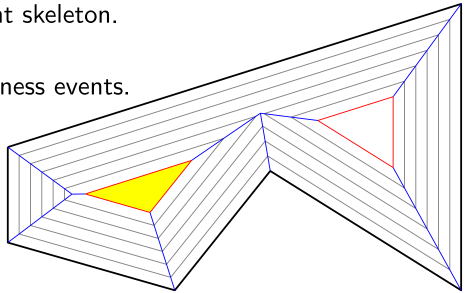

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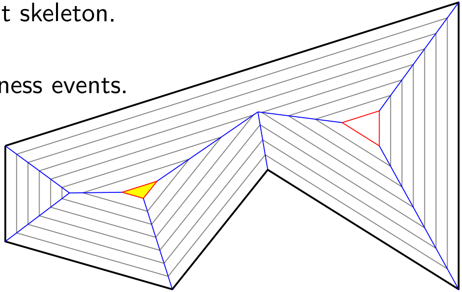

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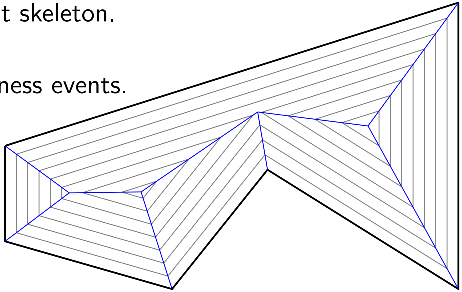

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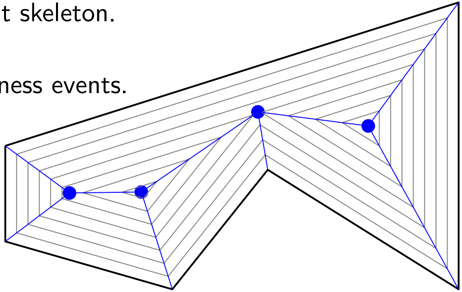

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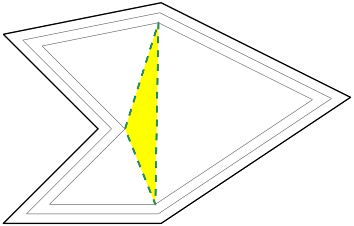

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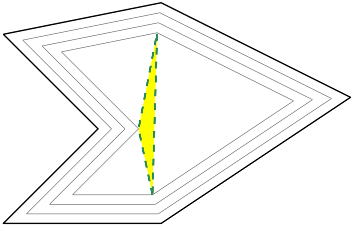

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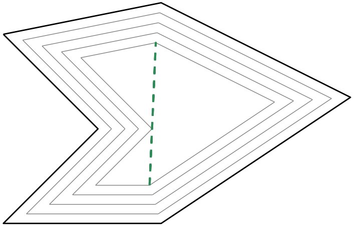

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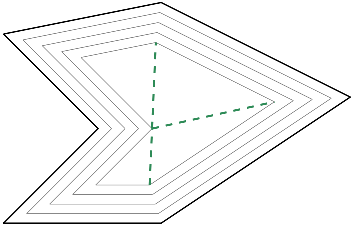

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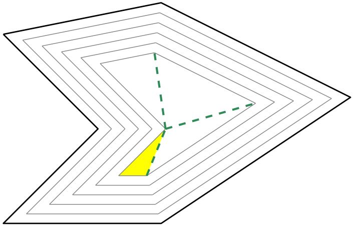

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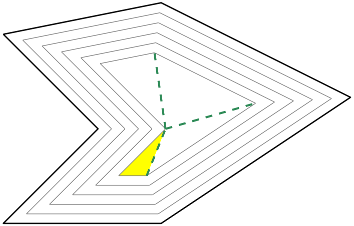

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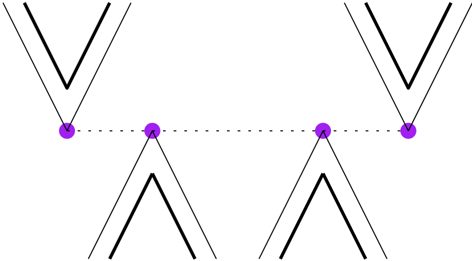

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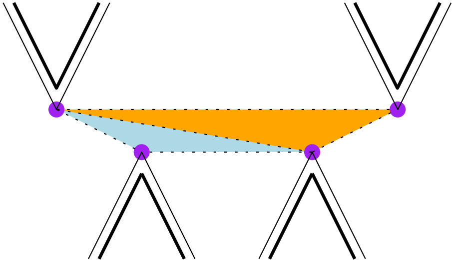

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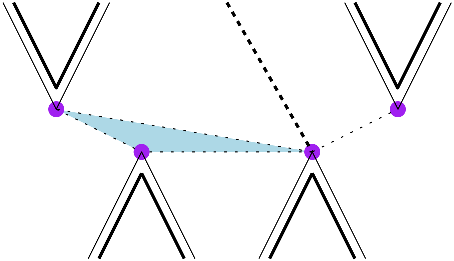

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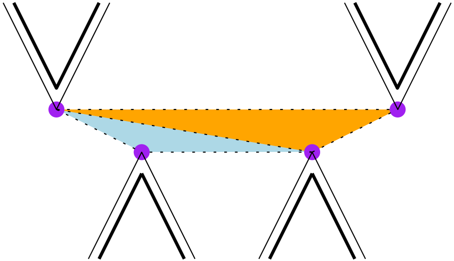

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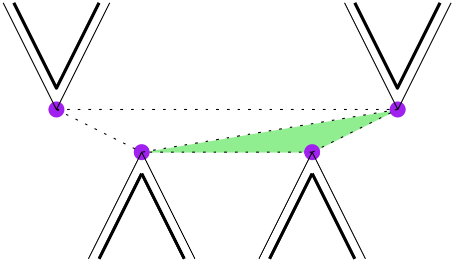

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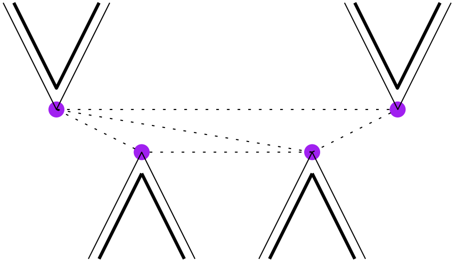

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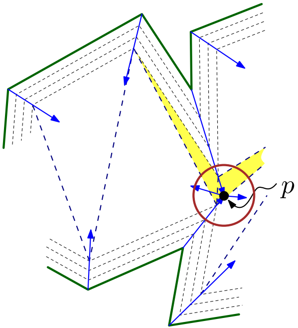

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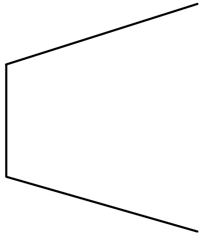

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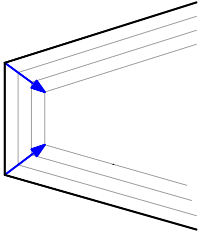

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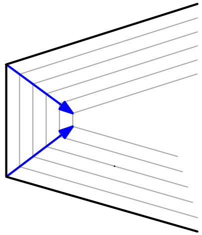

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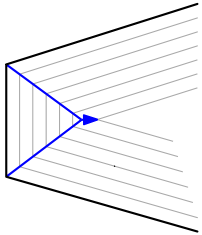

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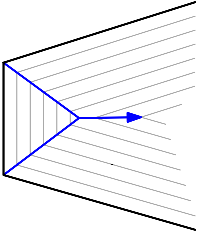

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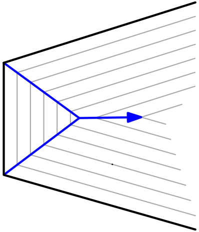

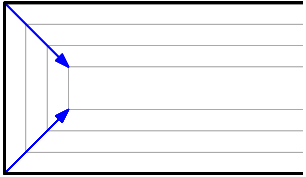

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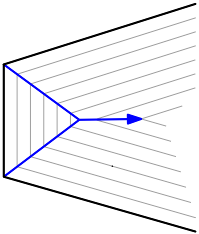

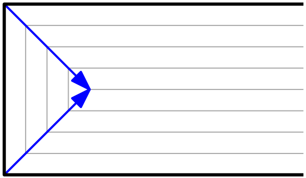

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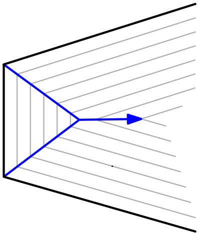

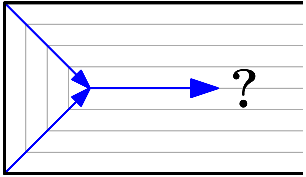

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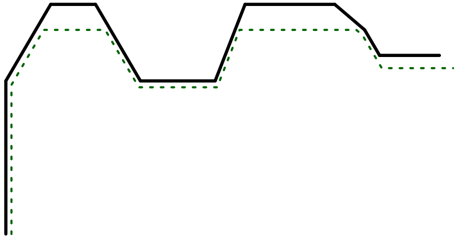

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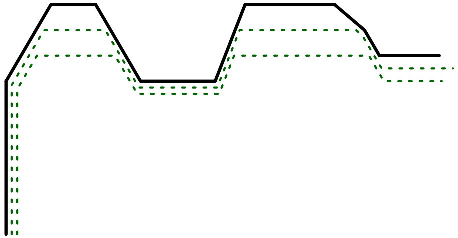

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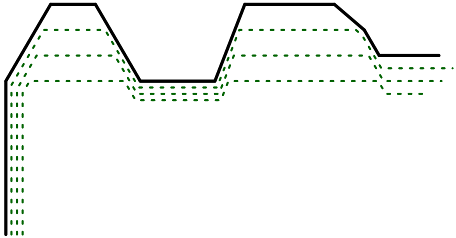

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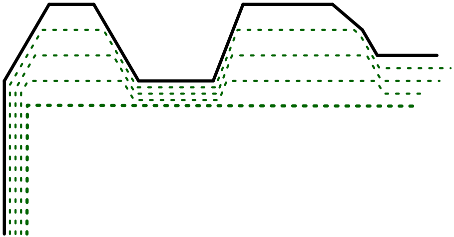

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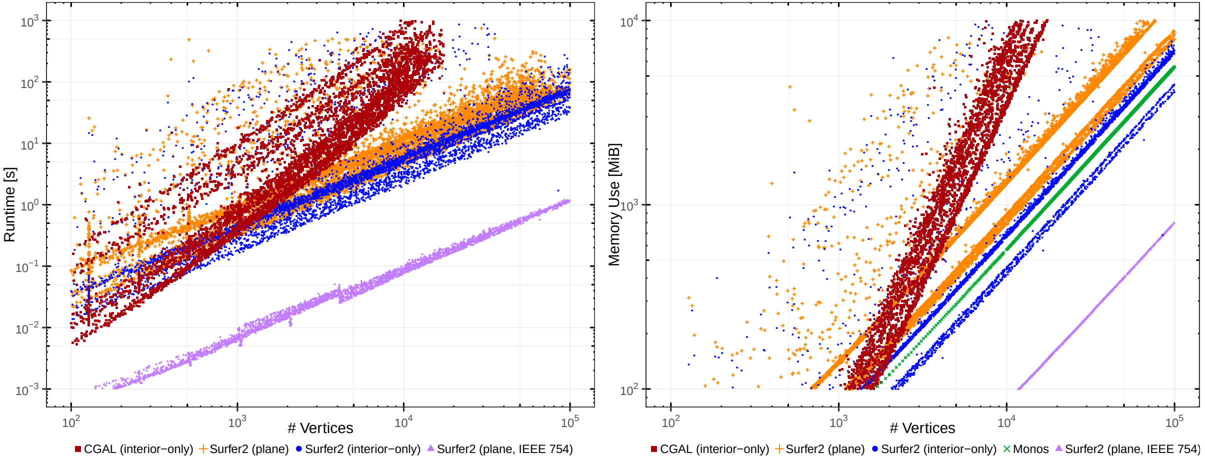
Runtime

CGAL v. Surfer2



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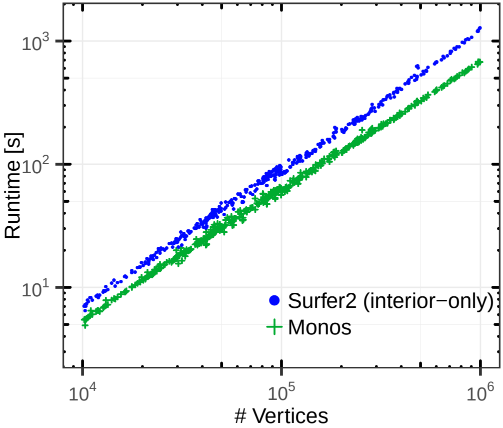
Monos v. Surfer2



Investigating the spread

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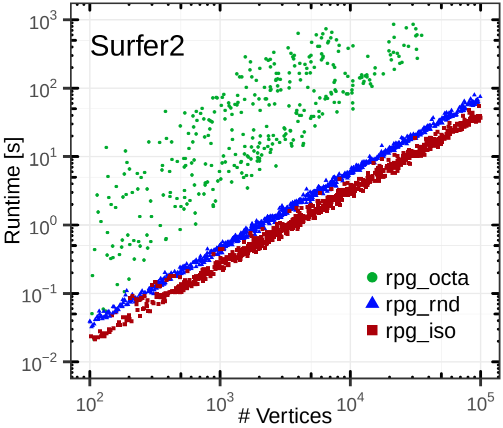

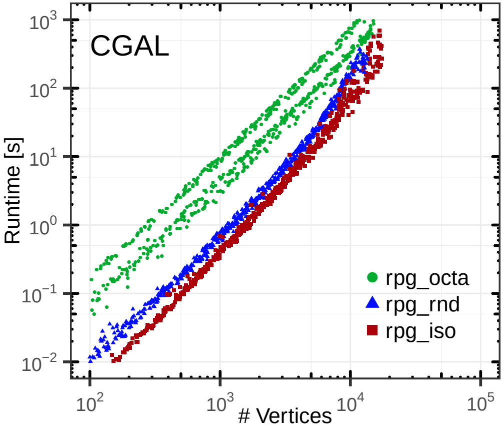

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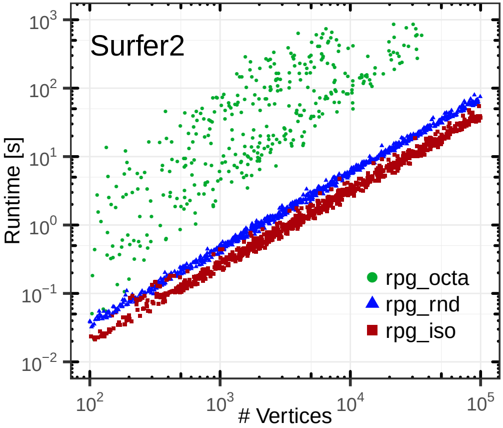

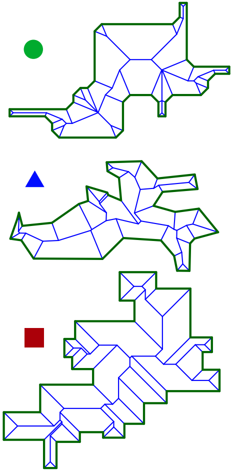

- Why is `iso` less problematic than `octa` input?
- Turns out our `octa` input was on the integer grid, the `iso` had random coordinates.
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- Indeed, with random edge weights, the spread goes away.
- We can split triangles by component, as the skeletons are independent.

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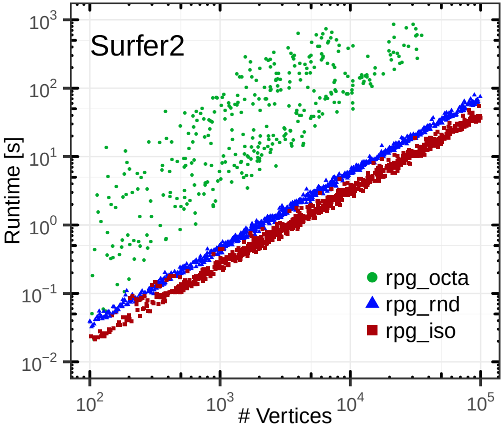

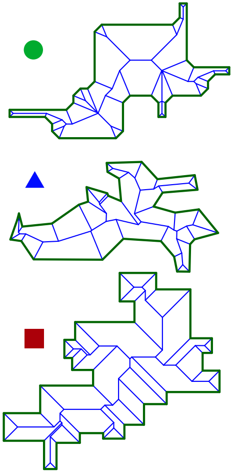

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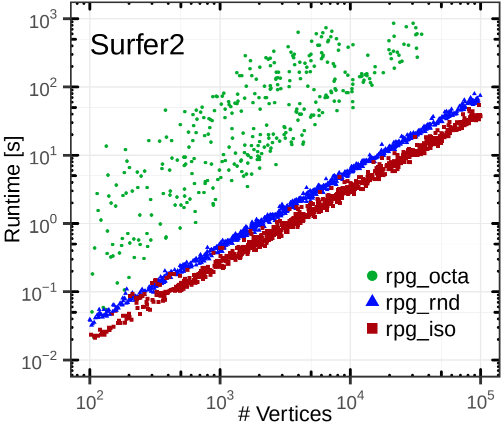

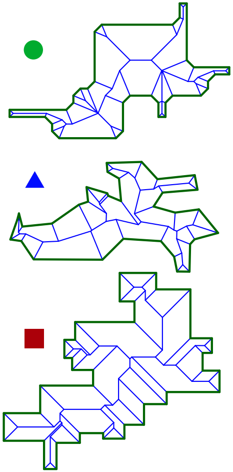

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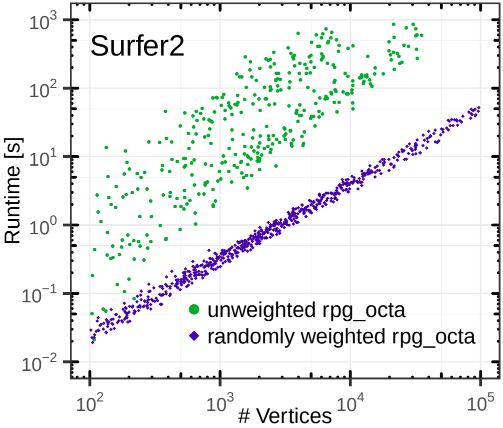

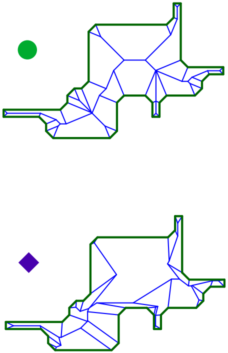

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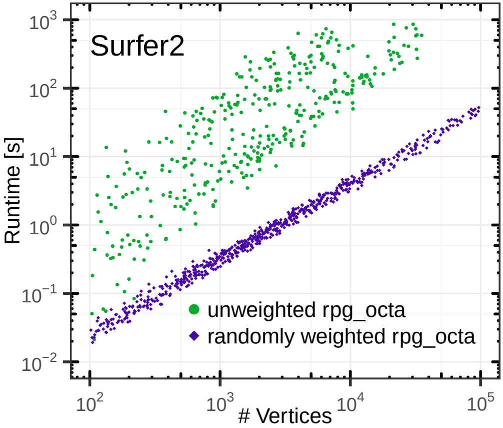

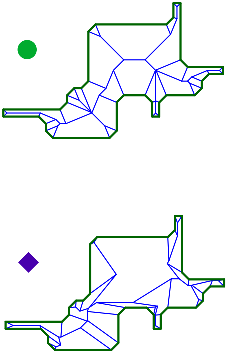

- Why is `iso` less problematic than `octa` input?
- Turns out our `octa` input was on the integer grid, the `iso` had random coordinates.
- This resulted in significantly many co-temporal events for the `octa` input.
- Indeed, with random edge weights, the spread goes away.
- We can split triangles by component, as the skeletons are independent.

Source code

- Monos: `https://github.com/cgalab/monos`
- Surfer2: `https://github.com/cgalab/surfer2`

Thanks!

Questions? Mail `palfrader@cs.sbg.ac.at`

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