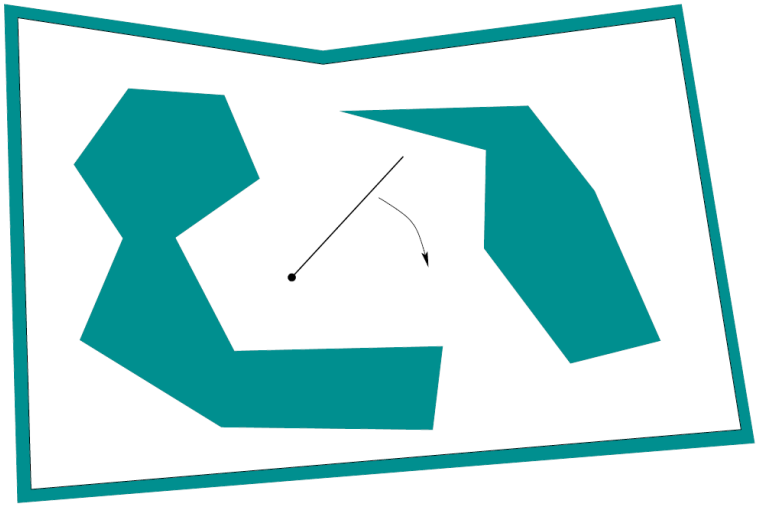
A Decomposition for a Line-Segment Robot

Planning Problem



- 2D World, $\mathcal{W} = \mathbb{R}^2$
- Translation is possible
- Rotation is possible
- Point is represented as (x, y, Θ)

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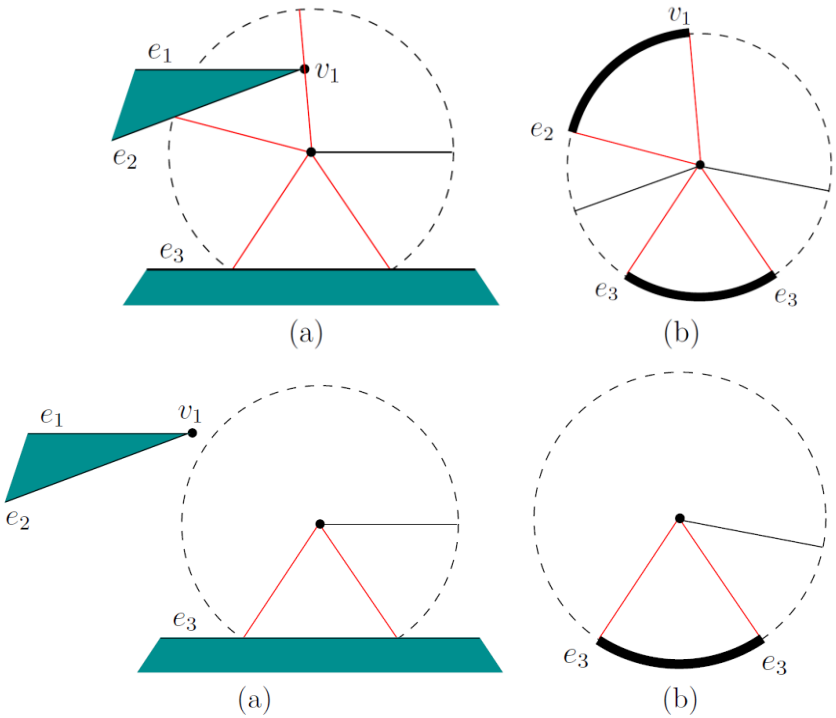
Radar Maps



Translation case

- Make a cell decomposition for the translation only
- Find $\mathcal{C}_{obs}$ using one of reviewed methods with *EV* and *VE* contacts
- Polygonal $\mathcal{C}_{obs}$ produces a stack of *K* regions

Rotational case, *numerical approach*

- Fix *(x, y)* and swing the segment for all values of *Θ*
- Form the roadmap by connecting sampling points
- *K* should be large enough
- Works well, but the method is *resolution-incomplete*
- Line segment can **not** get from left to right region – *critical change*, different cells for all decompositions

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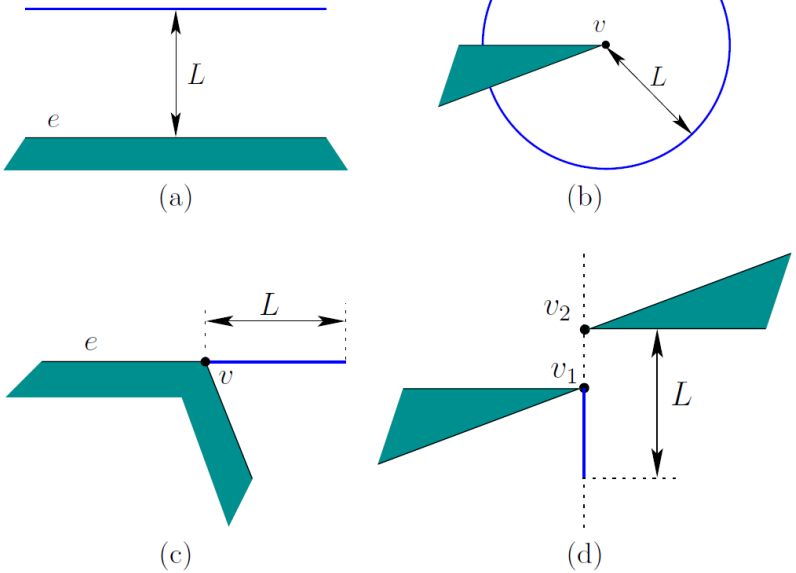
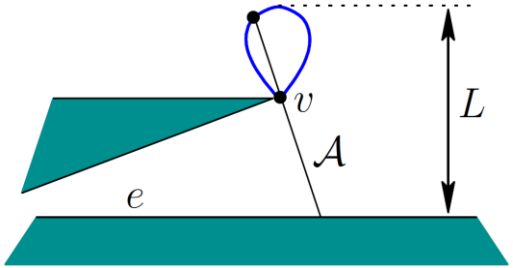
Critical Changes



Critical changes

- *(x, y)* is within *L* of an edge
- *(x, y)* is within *L* of a vertex
- *A* changes between being able to touch *e* and *v*
- Bitangent case (always produce curves in pairs)
- Conchoid of Nicomedes



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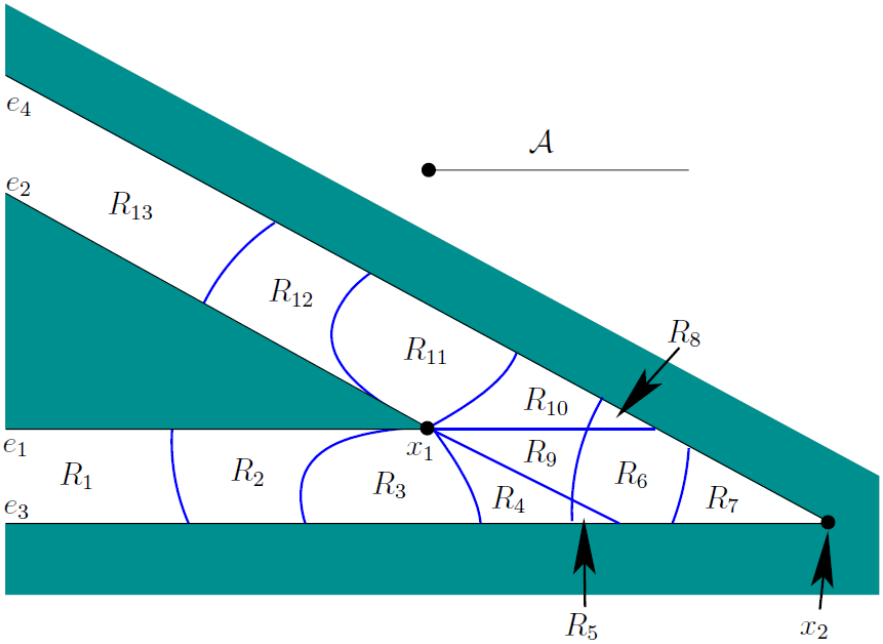
Putting All of the Curves Together



Changes occurrence:

- Intervals appear
- Intervals disappear
- Intervals split apart
- Intervals merge into one
- Feature of an interval changes

- **Noncritical regions** - no change in circular representation

$$([f_1, f_2], [f_3, f_4], [f_5, f_6], \ldots, [f_{2k-1}, f_{2k}])$$

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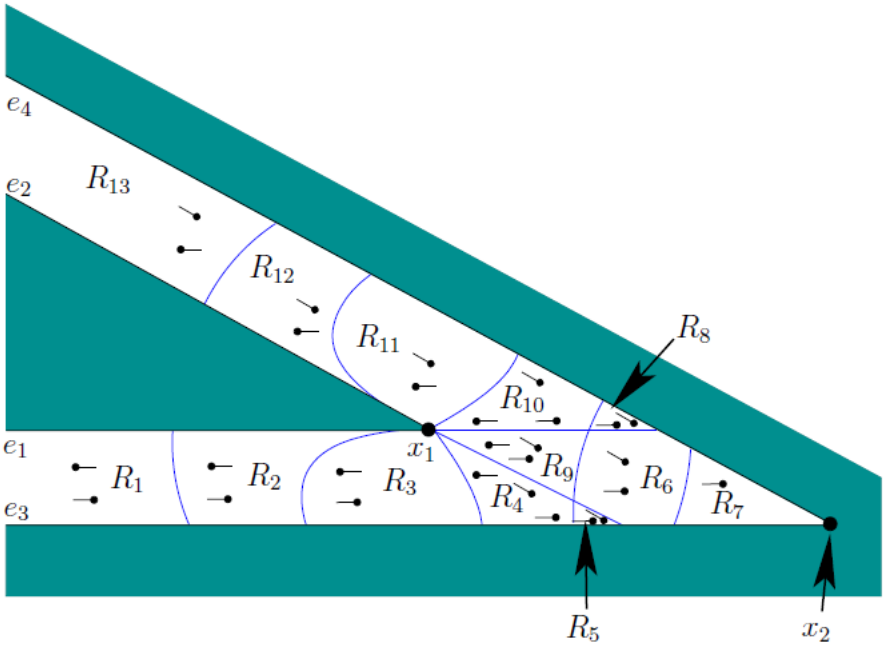
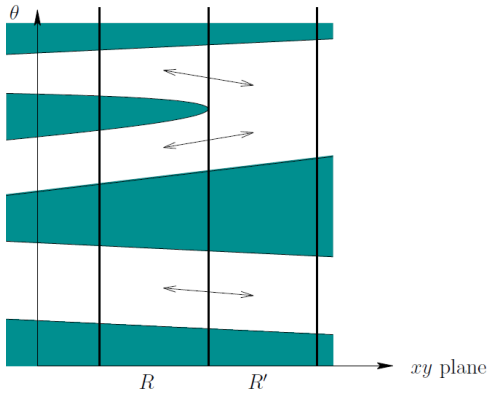
Constructing the Roadmap



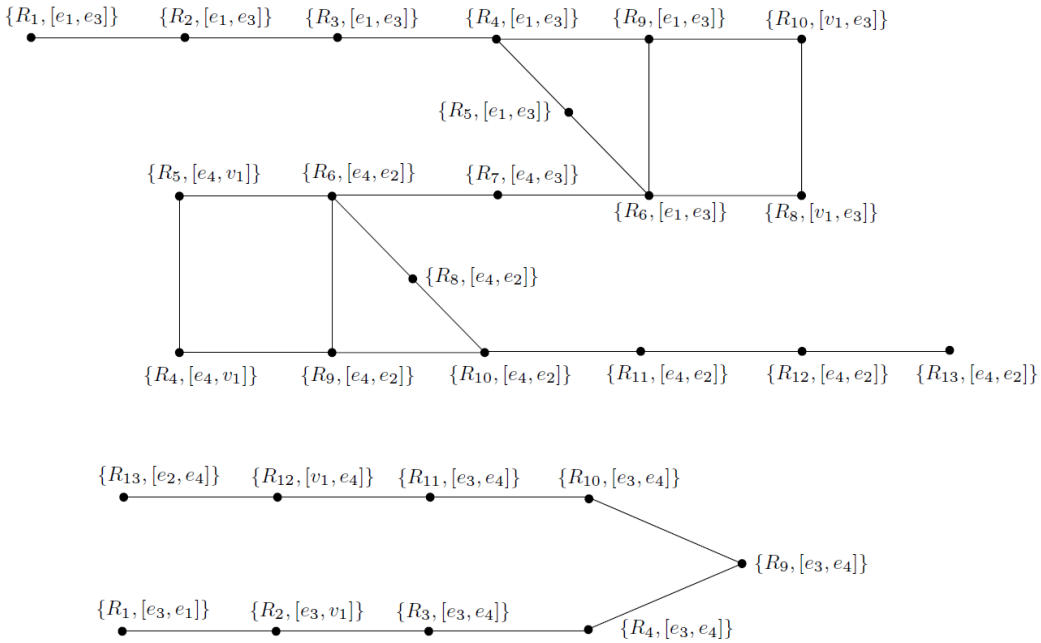
Which cells are actually adjacent?

- If neighboring cells share the same feature pair
- Feature changes, while the interval remains unchanged
- Check 2-cells and 3-cells



A Decomposition for a Line-Segment Robot

Constructing the Roadmap & Complexity



Translation case

- *O(n)* different ways to generate critical curves of the first three types
- *O(n²)* different ways to generate bitangents and the Conchoid of Nicomedes (based on pairs of features)
- Curves will intersect and generate at most *O(n⁴)* regions
- Above each noncritical region could be *O(n)* 3-cells

- Therefore, the size of the cell decomposition is *O(n⁵)*

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Constructing the Roadmap & Complexity