

# Investigating Geometric Multicuts

## When the fence is a single polygon and there are only two colours

### Minimizing the number of links when each colour has one polygon

- An  $O(n \log n)$ -time algorithm for finding an optimal fence (Wang; 1991)
- This paper finds a polygon between two nested polygons
- The reduction is explained in “finding a minimal chain to separate two polygons” (Wang; 1989).
- A linear time algorithm that finds a polygon with  $\text{OPT} + k$  edges
- $k$  can be 1 (Wang; 1991), or 2 (Baum, Bläsius, Gemsa, Rutter, Wegner; 2018)

### Minimizing the number of links when one of the colours can have more than one polygon

- The complexity of the problem not known (Baum, Bläsius, Gemsa, Rutter, Wegner; 2018)
- A heuristic algorithm (Baum, Bläsius, Gemsa, Rutter, Wegner; 2018)

### Minimizing the number of links when both colours can have more than one polygon

- Claimed to be NP-hard by Baum, Bläsius, Gemsa, Rutter, Wegner (2018)
- Cites a paper by Guibas, Hershberger, Mitchell, Snoeyink (1993)
- The reduction does not seem obvious (investigate)

## When the fence is a single polygon and there are two point sets of different colours

### Minimizing fence length

- Proved NP-hard (Eades, Rappaport; 1993)
- An exp-time algorithm (Reinbacher, Benkert, van Kreveld, Mitchell, Snoeyink, Wolff; 2008)
- Improved by Núñez and Rappaport (2006)

### Minimizing the number of links

- Proved NP-hard in “On the complexity of min-link red-blue separation” (Fekete; 1992)
- An approximation algorithm (Mitchell, 1993)
- In “Approximation Algorithms for Geometric Separation Problems”

## When the fence can consist of multiple polygons

### Minimizing fence length with only two colours

- An  $O(n^4 \log^3 n)$ -time algorithm (Abrahamsen, Giannopoulos, Löffler, Rote; 2019)
- Converts the problem to finding a minimum cut in a flow network

### Minimizing fence length with $k$ colours ( $k > 2$ )

- Proved NP-hard (Abrahamsen, Giannopoulos, Löffler, Rote; 2019)
- A  $(2 - 4/3k)$ -approximation algorithm (Abrahamsen, Giannopoulos, Löffler, Rote; 2019)

## Problem variations

### Fence shape: single/multiple polygons; a convex polygon

- Other possibilities
- Polygons with orthogonal edges
- Polygons with monotone upper and lower curves

### Number of colors

- Results on one colour are not included in this document

### Number of polygons in each colour