Scaling DCEL Overlay Operations to Support Dangle and Cut Edges

Andres Oswaldo Calderon Romero

University of California, Riverside

November 2024

Outline

Introduction

- Extension of previous DCEL work for supporting dangle and cut edges.
- Introduction of a new kd-tree partitioner for overlay operations.
- Improvement in handling real-world datasets with scattered line segments.
- Overview of the partitioning strategy and overlay technique.

Motivation

- Many applications require handling noisy or incomplete polygon data.
- Challenges with existing techniques in managing scattered spatial data.
- Need for scalability in overlay operations.

Kd-tree Partitioning Strategy

- Kd-tree: Data-oriented approach using midpoint-based splits.
- Quadtree comparison: Space-oriented approach with uniform splits.
- Advantages of kd-tree in reducing empty partitions.

Overlaying Polygons with Dangle and Cut Edges

- Extends DCEL overlay for datasets with scattered line segments.
- Integration of scalable polygonization for dangle and cut edges.
- Examples of overlay operations for applications in urban planning, advertising, and more.

Kd-tree vs Quadtree Performance

- Evaluation on MainUS and GADM datasets.
- Comparison of tree construction, partitioning, and overlay times.
- Kd-tree shows improved performance with fewer empty cells.

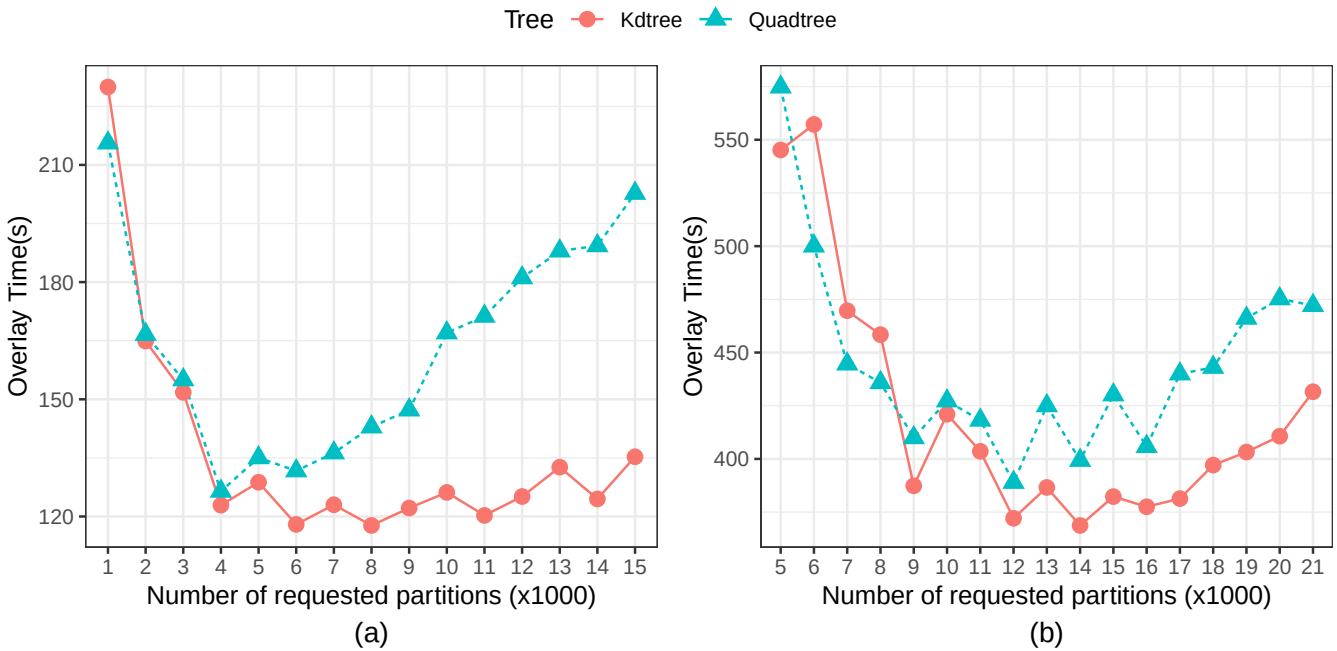

Figure: Kd-tree vs Quadtree performance comparison.

Overlaying Polygons with Dangle and Cut Edges

- Comparison of overlay results across states.
- Performance influenced by dangle and cut edge count and intersections.
- Example: Texas and California with large datasets.

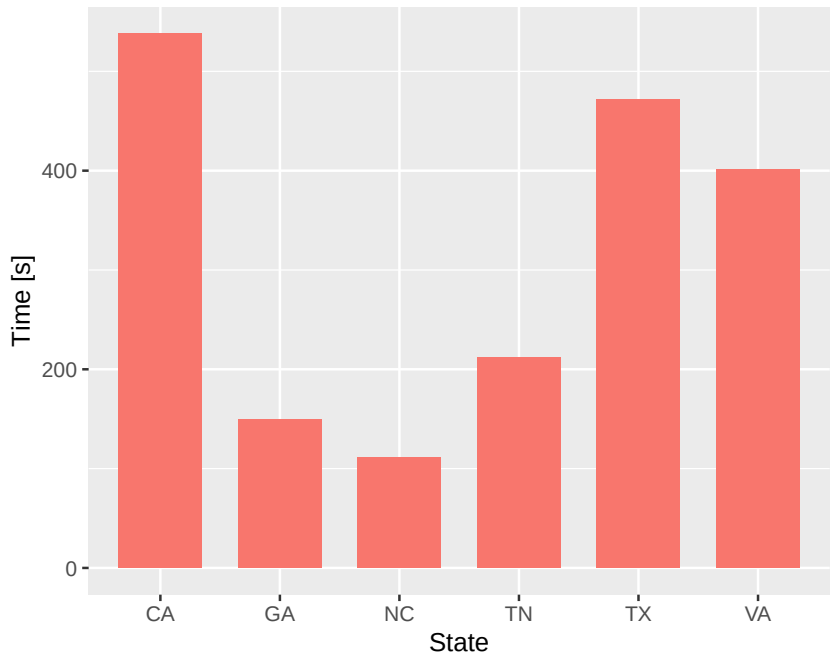

Figure: Overlay performance for different states.

Conclusion

- Kd-tree improves partitioning efficiency for large spatial datasets.
- Effective handling of scattered line segments in DCEL overlay.
- Scalability demonstrated in experimental evaluation.