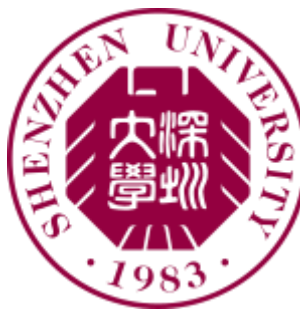
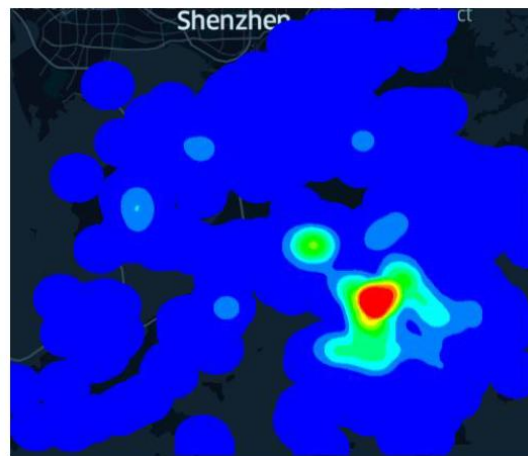
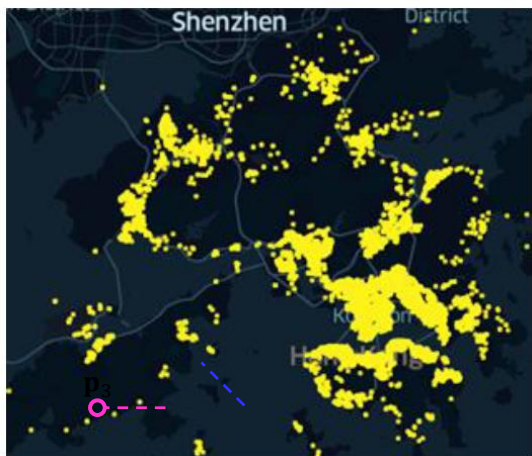




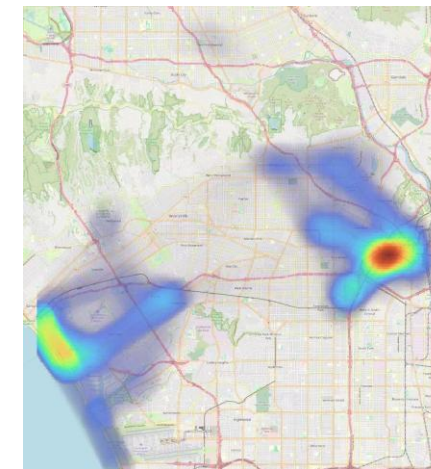
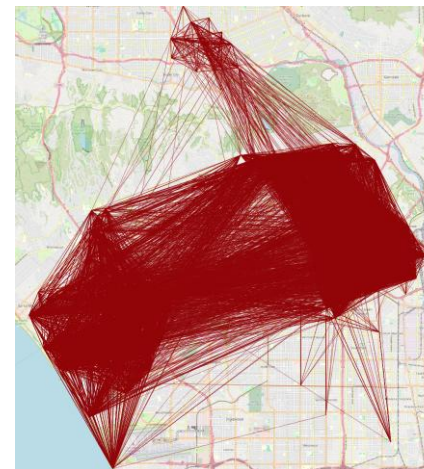
Large-scale Geospatial Analytics: Fast Method and Software Development

(Edison) Tsz Nam Chan, Dingming Wu
Shenzhen University

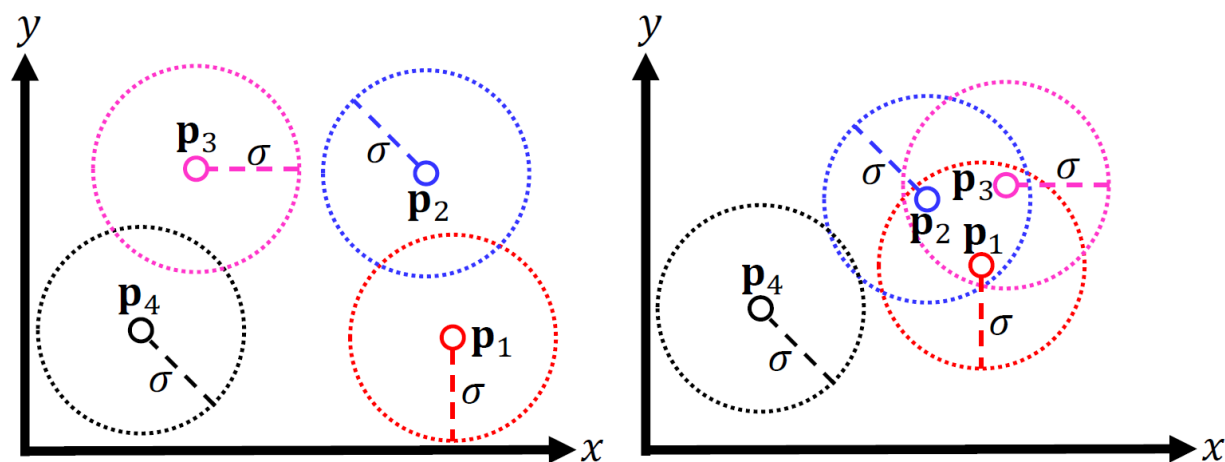
What is Geospatial Analytics?



Kernel density visualization



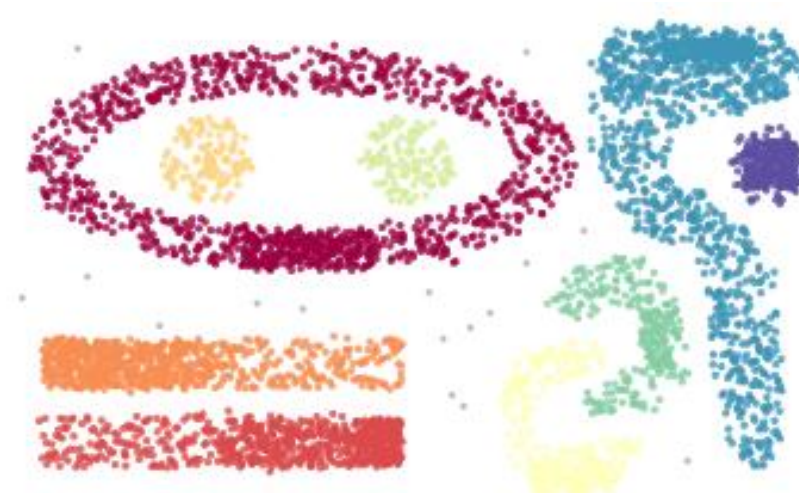
Line density visualization



(a) Dispersed

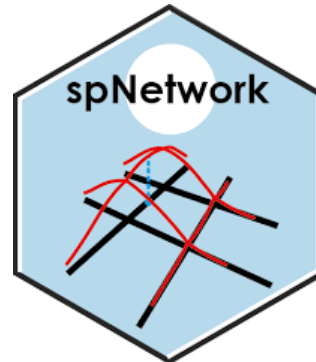
(b) Clustered

K-function analysis



Point clustering

Contemporary GIS Software Packages



Weakness of Geospatial Analytics

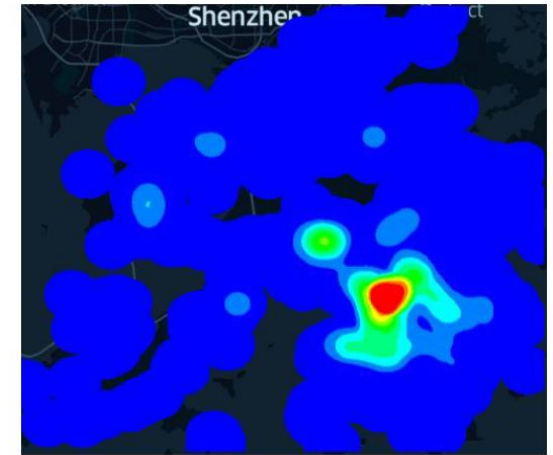
- GIS software packages are very slow. ☹️
- Reasons:
 - High time complexity.
 - No efficient algorithm development.
 - No deployment.
- Consequence: Cannot be scalable to large-scale datasets.

Weakness of Geospatial Analytics

- Example: Generating heatmap based on kernel density visualization.
 - Resolution size: 2560×1920
 - Number of data points: one million.
 - Number of operations: 4.915 trillion operations ☹️
- Cannot be feasible even for million-scale datasets. ☹️



Point dataset



Heatmap

Our Solutions

- **Kernel Density Visualization (KDV)**

- Develop the sweep-line algorithm (SLAM), which reduces the time complexity from $O(XYn)$ to $O(Y(X + n))$. ☺

- **Spatiotemporal Kernel Density Visualization (STKDV)**

- Develop the prefix-matrix-based algorithm (PREFIX), which reduces the time complexity from $O(XYTn)$ to $O(XYT + n)$. ☺

- Other complexity-reduced algorithms for

- Network and Network-temporal kernel density visualization (NKDV/NTKDV)
- Network and Network-temporal K-function
- Spatiotemporal K-function
- Line density visualization

Our Software Packages



Fast Density Analysis

Plugin ID: 3025

A fast kernel density visualization plugin for geospatial analytics

Download latest



Fast Density Analysis



Fast Line Density Analysis

Plugin ID: 3396

A fast line density visualization plugin for geospatial analytics

Download latest



Fast Line Density Analysis

fastnsa 0.2.0

High-performance network-constrained spatial point pattern analysis in Python

pip install fastnsa



Description

Release files

Security

Release history

FastNSA

FastNSA is a high-performance toolkit for **network-constrained spatial analysis**, designed for large-scale road networks and massive point datasets. It provides a Python interface backed by a native implementation for efficient spatial indexing and network-based statistical computation.

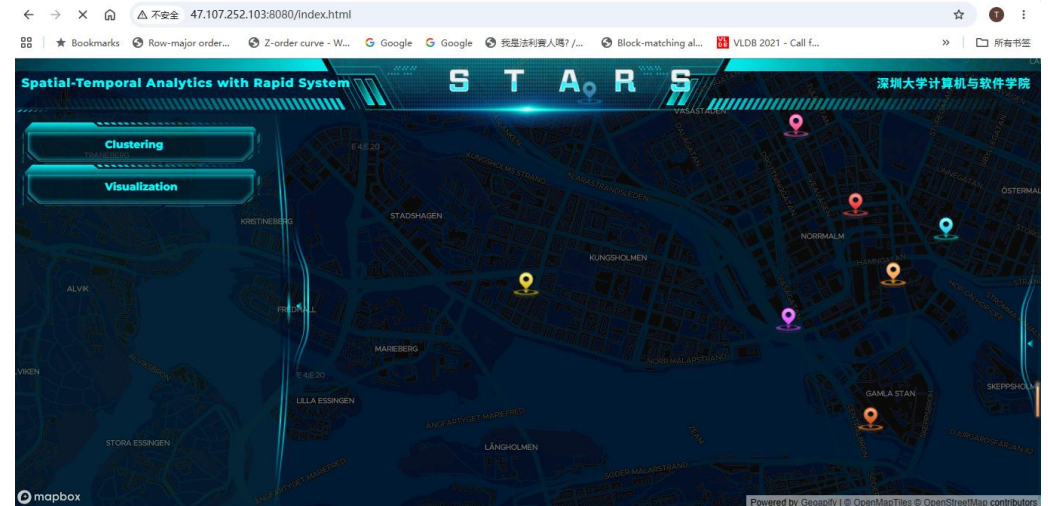
Key dates

PyPI data

Released: Feb 14, 2026

LATEST RELEASE

Fast Network Spatial Analysis (FastNSA)



Spatial-Temporal Analysis with Rapid System
(STARS)

Future Work

- Develop efficient algorithms for other GIS tools.
 - Inverse distance weighting (IDW)
 - Kriging
 - DBSCAN clustering
 - Moran's I
 - Getis-Ord General G
- Integrate these algorithms into unified QGIS and ArcGIS plugins.
- Integrate these algorithms into unified python and R software packages.
- Integrate these algorithms into a unified web-based system (STARS). ⁸