Fast Range Query Processing for Geometric Objects

The invention provides a backend method for fast pruning of range queries on trajectories and other geometric objects. Database objects are encoded as compact Bloom-filter-based signatures, while the query object is first expanded by a configurable distance buffer and converted into the same representation. This enables efficient bitwise elimination of incompatible candidates before exact similarity measures are evaluated. As a backend feature for processing motion data, its broad range of applications include mobility services, logistics, aviation, shipping, agriculture, and Industry 4.0.



Scalable Parallel Search for Similar Trajectories

IP RIGHTS
EP and US Patent Applications Filed
2022

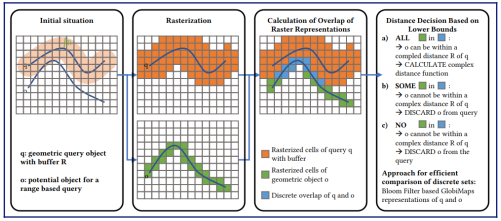
Database trajectories are represented by compact binary signatures. A query trajectory is expanded by a configurable distance buffer and encoded in the same format, enabling fast bitwise elimination of incompatible candidates before exact distance calculations.

REFERENCES:
Patent apl. EP4336377A1

01 Compact indexing: Database objects are represented by small binary signatures for efficient storage and fast comparison.

02 Parallelizable processing: Simple binary operations enable distributed and hardware-accelerated execution (e.g., FPGAs)

03 Compatibility: Can be integrated into existing database and query-processing environments.



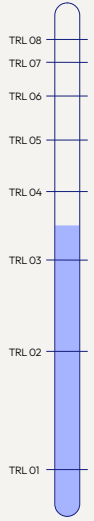
Overview of the general methodological approach to efficiently prune range queries on complex geometric objects (First published in P. Walther, C. Rieger. & M. Werner. Efficient Pruning of Range Queries under Fréchet Distance, CCIS, New Trends in Database and Information Systems, 2026 by Springer Nature)

CHALLENGE

The rapid growth of trajectory and geospatial data (e.g. navigation, traffic management, logistics and autonomous driving) is increasing the need for efficient similarity search and range query processing. However, exact distance measures such as Fréchet distance are computationally expensive, while conventional prefiltering methods based on minimum bounding rectangles or start/end points often fail when trajectories share similar spatial extent but differ in their actual path.

INNOVATION

The invention introduces a scalable method for efficiently filtering and comparing geometric objects, particularly trajectories. Spatial objects are rasterized and encoded as compact Bloom-filter-based signatures. For a query, the reference trajectory is first expanded by a configurable distance buffer and converted into the same representation. Bitwise comparison then eliminates database objects whose indexed footprint is incompatible with the buffered query, before exact distance measures such as Fréchet distance are computed.



01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

BayPAT

Innovation from Research & Science – BayPAT markets inventions on behalf of the Bavarian universities and universities of applied sciences.

An invention of **Technical University of Munich**

Technische Universität München

As one of the largest technology transfer offices in Germany, BayPAT evaluates and commercializes innovations from 28 research institutions. With our extensive experience and expertise in patenting and licensing technologies and our comprehensive range of services, we are your partner of choice. For more information visit www.baypat.de

Bayerische Patentallianz GmbH
Maryam Pirmoradi
mpirmoradi@baypat.de
+49 (0)89 5480177-39
Prinzregentenstr. 52
80538 München

