# Scaling Geometric Monitoring Over Distributed Streams

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## Data Stream Systems

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# The Geometric Monitoring Method



## Motivation



## Contributions

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# Geometric Threshold Monitoring

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# System Architecture

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# Computational Model

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# Computational Model

**Balancing Process** 



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# Geometric Interpretation

Convexity Property

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## Geometric Interpretation **Local Constraints**

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# Protocol

Decentralized Algorithm

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# Protocol Centralized Algorithm

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## Multi-objective Optimization

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### Non-linear Constraint Optimization Primal Descent

## Feasible Directions

Theoretical Tools

SQF

# The Savitzky-Golay Filter

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Theoretical Tools

# Maximum Weight Matching

The Primal-Dual Method

Related Work

Related Work



Problem Statement

## Problem Formulation



# The Geometric Monitoring Framework



# The Distance-based Hierarchical Clustering The Idea

# The Distance-based Hierarchical Clustering

The Weight Function

# The Distance-based Hierarchical Clustering The Algorithm



# The Heuristic Balancing The Idea



# The Heuristic Balancing

The Optimizing Function



# The Heuristic Balancing

The Function Formulation



# The Heuristic Balancing

The Algorithm

# An Nested Optimization Problem

## Velocity and Acceleration Estimation via SG Filtering



## Implementation Challenges



Data & Setup

# Synthetic Data

Data & Setup

Real-world Data



Experiments

## **Notation**



Experiments

## RAND, DIST, DISTR Comparison

 ${\sf Experiments}$ 

GM, HM Comparison



Experiments

## GM, HDM Comparison Synthetic Data Monitoring

Experiments

# GM, HDM Comparison

Air Pollution Monitoring



Conclusion

Summary & Concluding Remarks



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Future Work

### Future Work



The end Questions?