

CROWD BEHAVIOR ANALYSIS

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Introduction

Crowd behavior analysis is an important field of research in modern world. It has wide applications in surveillance and public safety which are one of the prime social concerns. One way to analyze crowd behavior is obtain crowd movement data and then find out outliers in the individual trajectories to infer any abnormal behavior in the crowd.

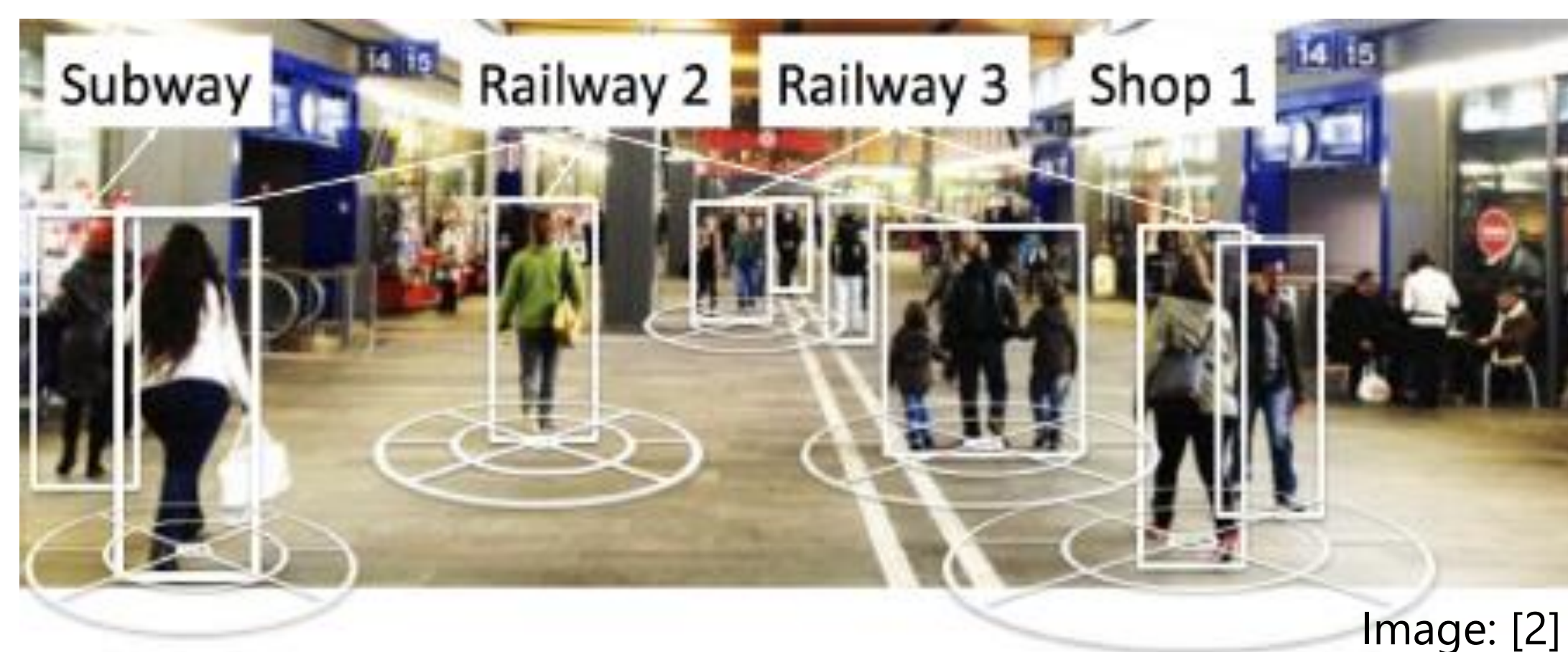


Image: [2]

We have implemented a system that takes a set of trajectories obtained from crowd data and detects the outliers in that set. A trajectory is a sequence of points (x, y, t) , where x, y are the ground co-ordinates of the person at time t .

Methodology

The trajectory outlier detection process involves three steps:

Partitioning, Detection and Marking.

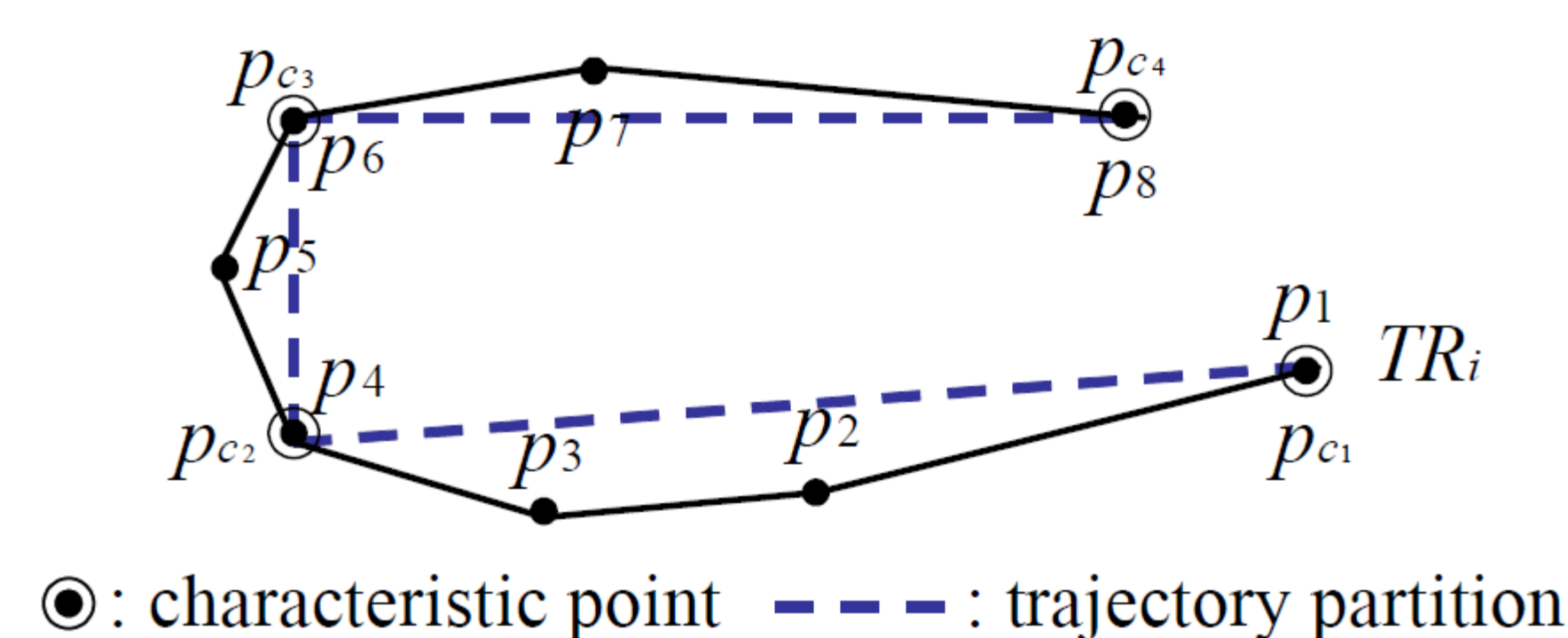


Image: [1]

All the trajectories are partitioned into line segments called t-partitions. The technique used for partitioning a trajectory in smaller line segments is based on the principle of Minimum Description Length [3]. The distance measure (D) for the t-partition is visualized in the following figure.

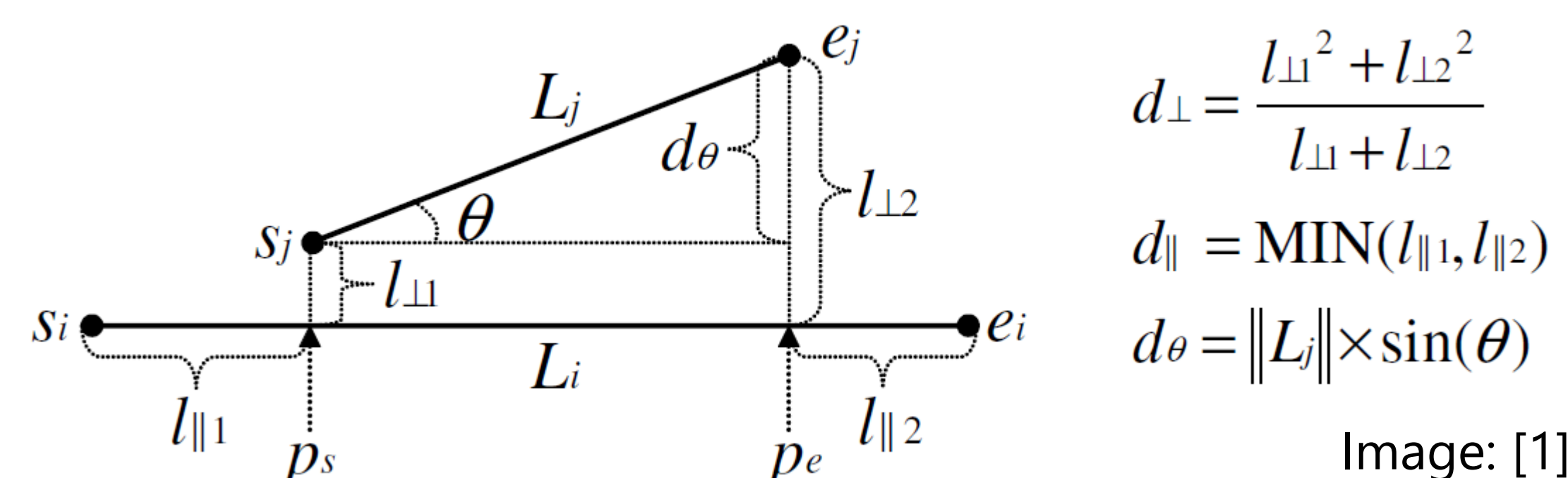


Image: [1]

For each t-partition we find out the set of trajectories that are close to it. If the number of such trajectories is less than a fraction $(1 - p)$ of total number of trajectories, then we say that the t-partition is an outlier.

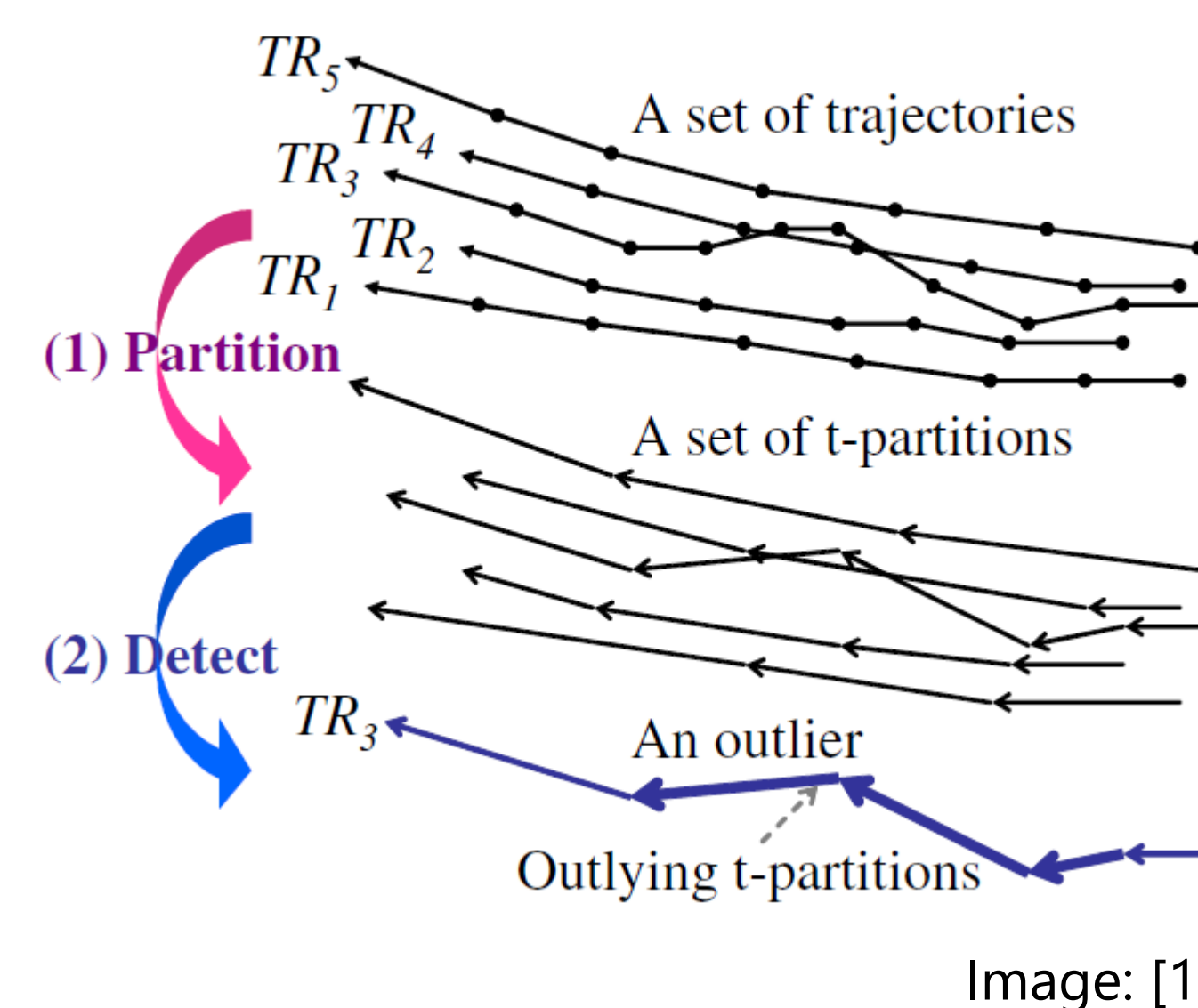
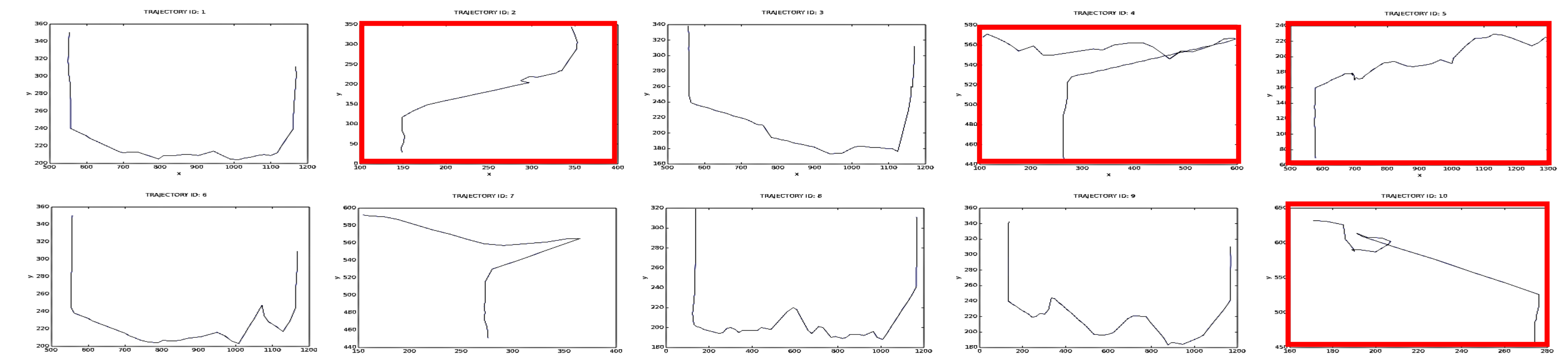


Image: [1]

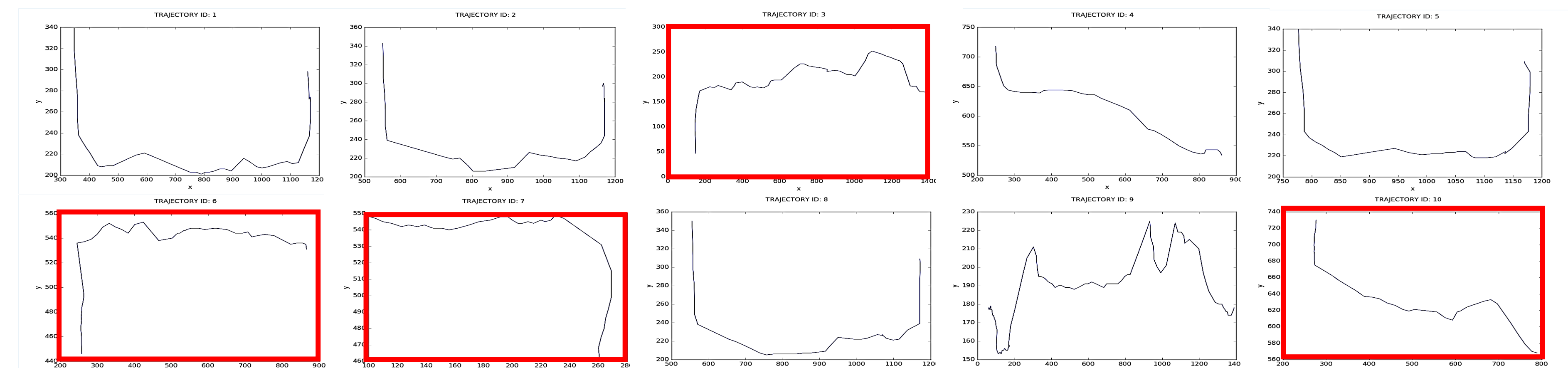
Now, if the ratio of length of outlying t-partitions to the total length of the trajectory is more than a threshold (F) , then we mark the trajectory as an outlier.

Results

These are plots of 10 trajectories, out of which 4 have been detected as outliers (the ones in red). The parameters used for this experiment were $D = 37$, $p = 0.99$, $F = 0.4$.



These are plots of another 10 trajectories and the outliers detected among them. $D = 37$, $p = 0.99$, $F = 0.4$



Hence, the outlier detection system successfully marks outliers that have different shape along with being more chaotic. The system can be used for any kind and any number of trajectories.

Novel Approach

We have incorporated temporal data along with spatial data for outlier detection. The similarity between trajectories in [1] is found through geographical location only but in our approach we have used speed also.

References

- [1] Trajectory Outlier Detection: A Partition & Detect Framework, Jae-Gil Lee, Jiawei Han, Xiaolei Li.
- [2] Socially-aware Large-scale Crowd Forecasting, Alexandre Alahi, Vignesh Ramanathan, Li Fei-Fei.
- [3] Trajectory Clustering: A Partition-and-Group Framework, Jae-Gil Lee, Jiawei Han, K.Y. Whang