Analysis of Trajectory Patterns and Identification of Geographical Mobility Borders

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ABSTRACT

Many research area such as, animal migration study, ecological analysis, mobility management, traffic analysis etc. there is need of identification of objects movement that arrives from certain place. Trajectory pattern identification is strategy for discovering object movements. For example, in animal migration study, zoologist required to learn the various movements of animals to notice interaction between various objects i.e. animals. During the survey of trajectory patterns different methods were implemented. There are certain kind of limitations are observed in previous system such as, end user does not have an idea about which kind of trajectory patterns are involved in their database. Hence it tends to an inefficient and inconvenient task. Many trajectory patterns are arranged with respect to their potentials and temporal restrictions. Unifying patterns are nothing but mining trajectory patterns of various temporal tightness. It has two phases first one is to discover the detail level of patterns and another is to construct a forest that represent the various patterns.

Keyword - *Trajectory pattern mining, synchronous movement patterns, moving object trajectories, trajectory clustering*

1.INTRODUCTION

A unifying trajectory patterns are defined as the set of moving objects having closed relationship in terms of location and time. Moving objects have synchronous movement which may communicate or interact with each other's. In unifying trajectory patterns set of objects are follow same path. An example of UT patterns can be a group of deer which migrates together at same time in same direction and hence they are closer to each other every time. UT pattern identification is very much useful to notice the interaction between moving objects such as, zoologist can learn about set of animal movement with the help of animal trajectories. Battleship trajectories are useful for commanders to extract enemy tactics. In soccer trajectories coaches can identifies attacking strategies of opponent etc. Previously existed UT patterns correspond to only one type of broad range type pattern. Such as, in flock pattern geographic data mining approach is used to detect tightness of patterns such as, flocking behavior and co-occurrence in geospatial lifeline data[7].

This tedious because user does not know that which type of trajectory pattern is involved in their dataset. User database may contains, multiple sets movement of objects arriving from various locations with different time interval such as, within one minute interval, one hr. interval and so on. Therefore, classification of such patterns may get into tedious task. One simple way to for classification of such patterns is discussed in [1], such as to build a framework having capabilities of handling trajectory patterns at different levels with temporal tightness. This strategy requires identifying sharpness of temporal suppression on patterns. Author F. Giannotti, M. Nanni[2]discussed about trajectory pattern mining problem with several methods to discover T-patterns from trajectory data. But the T-pattern is generalized technique for spatial-temporal data mining. It includes background information i.e. geographic information. In [3], partition-and-group framework is proposed for clustering trajectories. Using clustering trajectory TRACLUS is developed. For cluster validation visual inspection tool is developed in it.

Clustering trajectories are based on partitioning and group strategy which helps to identify sub-trajectories. In this technique for line segmentation density-clustering algorithm is used. The concept of swarm is proposed in [4] which capture movement of moving objects within the arbitrary shapes of cluster in specific time stamp. A method named as, Object Growth is implemented to retrieve the result patterns. Also to reduce search space, pruning algorithm used. Density-based clustering algorithm is used for trajectory data based on a simple notation of distance trajectory [5]. But problem with this algorithm that it does not provides refinement for adopted trajectories and it is not worked on real world datasets. Reporting Flock Patterns [6] observes more complicated patterns in the database. Complicated patterns are nothing but repetitive or hierarchical patterns. For this task tree based approach. According to our observation it is seems that, no such kind of system is existed that work for different levels of mining unifying trajectory patterns with temporal rigidity of patterns. Hence there is need of such system that works on discovering trajectory patterns of different temporal tightness or sharpness.

Many research have been conducted on trajectory pattern mining, previous systems only works for specific type of trajectory patterns i.e. only for single level trajectories. Users don’t have an idea about which type of pattern is included in their database hence mining trajectory patterns from high scale database may get a tedious and inefficient task. However, there is a need of such kind of system that can discover different levels of patterns which contain different temporal tightness and construct a pattern forest to discover more patterns.

2. RELATED WORK

In this section we are going to discussed related work about classification of trajectory patterns. As per the tightness temporal constraints there are three types classified into trajectory patterns.
They are explain as following:

A. Flock Patterns

Flock Patterns can be defined as a point cluster which represents the concurrence motion[2]. It is a large subset of moving objects along with close path to each other in certain time quantum. Several spatial-temporal patterns are defined as flock ,leadership patterns. To detect generic aggregation patterns flocking patterns mainly used[3]. Flock consist of REMO pattern concurrence as well as the involvment of spatial constraints. Detection of efficient pattern is more difficult task, it required to separate input data having equal time and equal motion so that n equal number of set of same direction and the same time can get. REMO[4] is strictly design for the seperation of the MPO i.e. Modeling design patterns. The seperation involves the managing and tracking data seperatly from analysis task[3-4]. MPO always keep track of exact lifeline of their data and make computation of their motion attributes in analysis phase. In[5], research on reporting floack patterns have been conducted by Marc Benkert,J. Gudmundsson et al, in this research they were determining that tree-based algorithm can well suitable for identifying flock patterns. However they very much depend on the characteristics of input set. M. Nanni and D. Pedreschi defined a time-focused clustering for mining trajectories of moving objects[13].
In[9], the problem of computation of longest duration flock patterns is discussed. There are many problems in trajectory pattern mining such as, propose and design techniques for more complex patterns and implemented techniques that can manage spatio-temporal data with errors and missing values.

B. Time-relaxed trajectory joins

Time relaxed trajectory joins manifested on basic symbolic join algorithms. Existingly, there was two kind of solutions or approaches are available, from that first approach is based on notion of multiple origins and the other is hueristic solution based on "divde and conquer" method[6]. This approaches are suitable where there is limited memory resources. Author Dimitris Sacharidis and K. Patroumpas discussed about hot motion path i.e.time relaxed trajectory joins to detect frequently traveled trails of numrous moving objects. Thery considered distributed settings,having co-ordinators maintaining hotness and geometrics of this paths. This wotk is only limited to freely moving objects.

Sub-trajectory clusters: A new framwork called as partitioning and grouping framework. It is utilised for trajectory clustering. In[7], TRACLUS algorithm is introduced for trajectory clusters. Main intension of TRACLUS algorithm is to detect sub-trajectories from large trajectory dataset. Sub-trajectory cluster can be defined as the set of clusters moving to similar direction.

A Framework for Generating Network-Based Moving Objects is discussed by Thomas Brinkhoff in [12], to evaluate spatio-based temporal database, as many applications dealing with the spatio temporal data. It is used to defined benchmark.

Above discussed techniques are the existing trajectory patterns. Now, we are going to discussed UT pattern mining and there exist problem in previous trajectory patterns.

C. UT mining

Moving objects mainly represents the synchronous movement of patterns as they interacting with each others. For example set of moving objects move together. On the other hand set of moving objects that moves in same direction in every year is called as asynchronous movement of patterns. Such kind of trajectory patterns are known as Unifying trajectory patterns. Unifying trajectory patterns can be defined as, set of moving objects togetherly that are closed related to the timestamp, Geo-location or may both. Example of trajectory pattern can be deer migration in Same direction and at the same time. As UT patterns useful to learn an interactions between object movement and possibly group dynamics, it is very useful in mining. In[2], flock patterns have been discussed by Patrick Laube and Stephan Imfeld. Flock pattern represents the concurrence motion. It also analyse the REMO i.e Relative Motion. Required trajectory patterns such as, flock, REMO, time relaxed trejectory joins, swarm pattern are also discussed in [2][3][4][5]and [6] respectively. Certain kind of limitations occurred in unifying trajectory pattern mining as user do not have knowledge that which type of trjectory patterns are hidden in the large database of trajectory pattern. Objects are moving arriving at several locations within one-minute interval, one-hour interval and so on therfore, while classifying trajectory patterns rigidity of temporal contraints on the patterns is considered.

An initial pattern discovery processed in two phases first is the sub-trajectory cluster and the other is search space limited to specific sub-trajectory cluster rather than whole dataset.

C.1 Sub-trajectory Clustering

Sub-trajectory clustering utilises hueristic solution based on divide and conquer method. Clustering moving objects is an interesting approach to catch regularities of the moving objects.In[10], the concept of micro-cluster moving is proposed. Theoretic clustering[11] is orgnised by RIC framework. It is implemented using greedy approach to prove goodness measure and efficiency of their propsed approach. RIC is a very flexible framework. It has several desired properties which is not in previous clustering mechanism.

Sub-trajectory clustering includes following phases:

a) Dividing or partitioning phase: In this phase each trajectory is partitioned into set of trajectory partitions or into line segment at the time of object moving in various directions rapidly. To search the set of partitioned point MDL principle [14-15]is utilised.
b) Conquer or groping phase: After partitioning all trajectories, another phase is grouping of obtained line segment into cluster. This phase utilises A density-based clustering method. In[9], density-based clustering method is described which is analogous to DBSCAN.

D. OLAP Operations(Drill-down and Roll-up operations)

Drill down operations occurred only if MDL i.e minimum description length descreases the cost. The main purpose of drill down operation is to gain multiple smaller time relaxed patterns from large time relaxed patterns. This operation is automatically selected to minimise the cost of MDL.

Roll-up operations represents the reverse of the drill-down operations. In this operationa merger never decreases the MDL cost.

Lastly, in reasearch[1], author Jae-Gil Lee,J. Han and X. Li. Defined a framework for discovering trajectory patterns. They represent very useful learning interactions between moving objects. There is certain limitation in their defined framework as user don't have idea about type of patterns involved in large dataset.

3. CONCLUSION

In this survey paper of mining trajectory patterns, we have studied the existing techniques of trajectory pattern mining. Previous techniques only deals with specific type of trajectory patterns. Also there was limitations on discovering patterns as user do not know which type of trajectory patterns involve in their large database. Acoording to our analysis we are aiming to overcome the limitations disscussed in literature survey by observing many trajectory patterns that can be arranged according to the strenght of temporal constraints.

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