EE/CprE/SE 491 WEEKLY REPORT 2

Feb 7 - Feb 13

Group number: 10
Project title: “Visualizing Probabilistic Whereabouts of Moving Objects”
Client &/Advisor: Goce Trajcevski

Team Members/Role:
Nathan Thoms - To be established
Mara Prochaska - To be established
Eric Jorgensen - To be established
Ryan Cook - To be established

Report Summary

This week we further learn, through reading research papers provided by our faculty member, about what is meant by visualizing probabilistic whereabouts. We have now been exposed to two different approaches to do so. One approach uses the intersection of cones filling a three dimensional space, 2 spatial, 1 temporal. A user interested in the probability of the moving object occupying a particular region across a given time interval could create a “query prism” occupying some area in the space. This probability is given by:

$$P = Overlap\ of\ \ Cone\ Intersection\ and\ Query\ Region\ /\ Cone\ Intersection$$

Another approach to calculating the probability that an object occupies a particular region of space is through use of maximum entropy bridgelets, or more plainly said, bridgelets. The main idea here is that you discretize space and time and limit the number of time steps you can take between two points. Then through use of an algorithm enumerate through all of the possible routes the object can take with this limitation. When many routes pass through a discrete location a higher probability is assigned to this location, the opposite holds for squares less traveled.

Accomplishments

As a group our primary goal was to become familiar with the provided research paper materials. We were assigned by our faculty advisor to read three papers; additional works were shared with us for exploring one dimensional feature sets varying in time - related to discussing two and three dimensional features.

Method Compare/Contrast

Both methods for objectively quantifying probabilistic whereabouts of a moving object share both similarities and differences. The most significant similarity underpinning the two methods is the speed constraint imposed. In the first method, a greater speed results in shallowly sloped, obtuse cones. This increases the cone intersection area, and with the query prism remaining constant between a velocity constraint adjustment would result in a lower probability of the object residing within it. In the second method the speed constraint is realized through the number of allowable discrete steps in space - meaning a lower velocity would force the taken steps to follow a straighter line between consecutive points in order to reach the destination. A major difference between the two methods is that the first allows for the object to travel from the first point to the second point in any fashion - meaning it could first travel away from the second point as long as it is traveling fast enough to turn around and reach it within the step duration. In the latter the motion is restricted to travel in a more direct path - namely, it cannot travel further away from the second point.

Potential Method Use Cases

We will certainly have two data sets, one containing GPS data with dimensionality 3 (2 spatial, 1 temporal), the other related to the position of a molecule/atom/particle with dimensionality 4 (3 spatial, 1 temporal). Given the different nature of how these objects move, the correct method will need to be used to produce the most meaningful results. When using GPS data it may be sensical to assume that the object at one point in time is not interested in moving away from the next point before heading in that direction. For this reason the second method seems more fitting. Particles however have more chaotic motion, and assuming they will only travel in a single direction might be illogical depending on the circumstances and data collected from the particular experiment.

Other Data Sets / Uses Notes

We are able to apply methods to other suitable datasets although we will only be provided with two. This freedom has yet to be further explored, although should be done so soon, as it plays an important role in identifying a concrete user base for our deliverable application

Pending Issues

We currently have no pending issues and have been enjoying learning the applications of this project.

Individual Contributions

Team Member	Individual Contribution	Hours this Week	Hours Cumulative
Nathan Thoms	Produced meeting notes and visualization tools.	5.5	8.5
Mara Prochaska	Continued research	2.5	4.5
Eric Jorgensen	Researched related topics	2.5	5.5
Ryan Cook	Looked over material given by Goce Trajcevski	2.5	4.5

Upcoming Plans

In the upcoming weeks, we hope to begin designing the application and refine the tools we will use to create it. We also plan to continue researching the methodology in order to have a better understanding of what the visualization of the algorithms will look like.

Action Items

Team Member	Individual Goals	Estimated Hours
Nathan Thoms		
Mara Prochaska		
Eric Jorgensen		
Ryan Cook		

Advisor Meeting Summary

During the Feb 13 meeting, we were able to continue discussing what we went over in the last meeting, as well as creating a timeline. In addition, we went over languages to use in order to implement the project, as well as possible cases of use for the visualization across different customizable dimensions based on required use and inputs/outputs.

Weekly Readings and Materials

1. Uncertain Range Queries and Necklaces
   (Goce Trajcevski, et. all)
2. Towards Fusing Uncertain Location Data From Heterogenous Sources
   (Bing Zhang, Goce Trajcevski, Liu Liu)
3. Maximum Entropy Bridgelets for Trajectory Completion
   (John Krumm)