IEEE ITSC 2020 UAS4T Competition Results

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Approach of the work

Step 1: Load the CSV data file and sort the data with the help of python code.
Step 2: WGS-84 coordinates are converted to planar (L-EST97)[1] coordinates
Step 3: Study segments are identified; data for the individual segments are extracted.
Step 4: Time-space plots are generated for the segments; quizzed metrics are evaluated.

Processing the data for analysis

The vehicular trajectory data is stored in the form of CSV files, making it difficult for data interpretation. In sorting the data, and make it understandable, python code is developed for the analysis. The flow of the python code is shown in the Figure1.

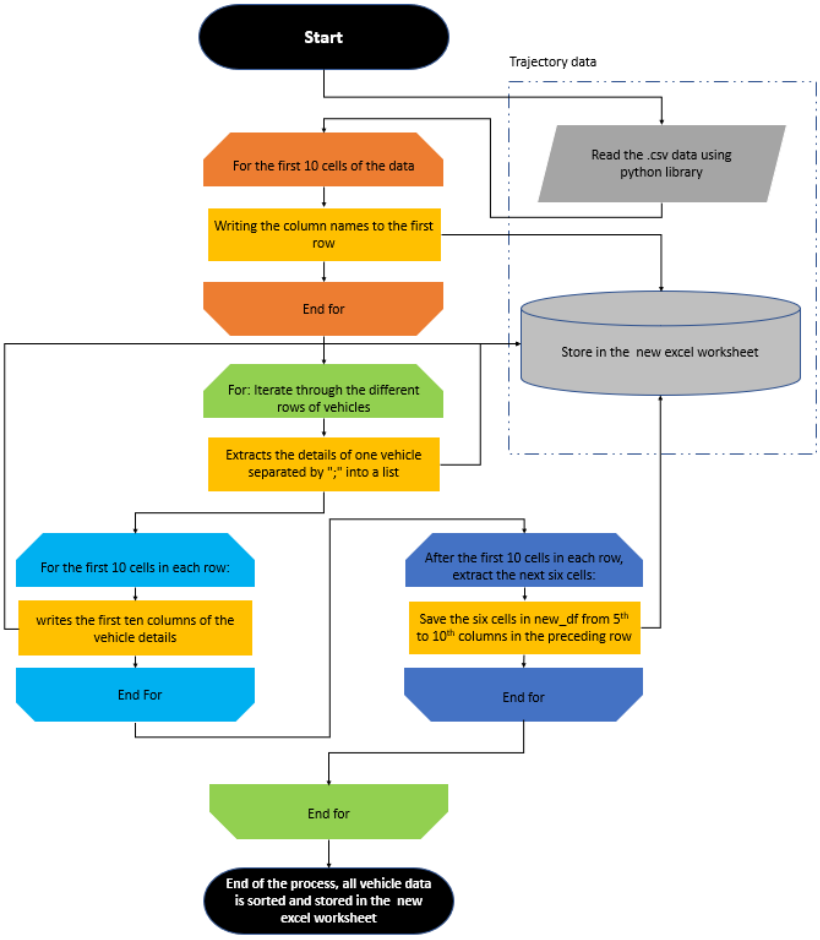
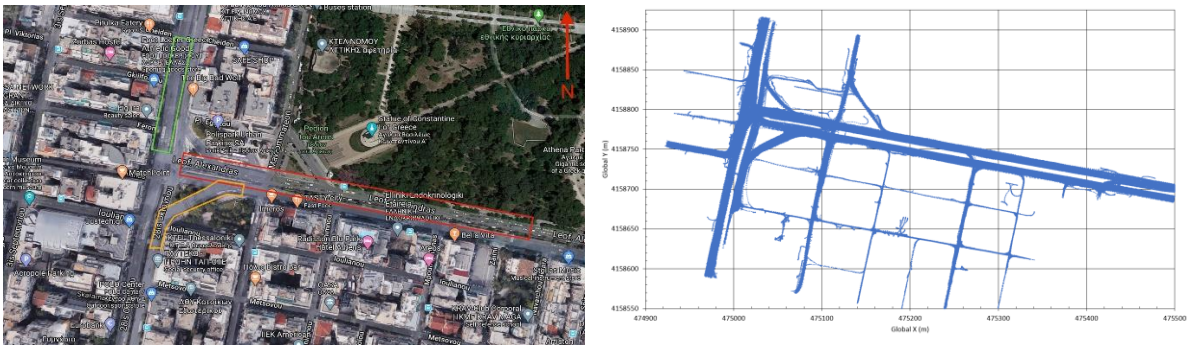


Figure 1 Flow of the python code in sorting the data

Based on the developed python code, the entire trajectory data is sorted and stored in terms of Excel workbook. It can be noted that the vehicle's positions are recorded in terms of latitude and longitude in the form of WGS-84 coordinates, which makes it extremely difficult for the analysis. Again, the same python code is customized. The positions of the vehicles are converted to the L-EST97 coordinates as a planar form in meters. Further, based on the transferred coordinates, the geological map of the study area and the vehicles' positions are

compared in figure 2. For the figure, it can be noted that the vehicles' data points take the form of the road sections in the study area. In this competition, it is asked to evaluate the three road sections, as shown in figure 2(a).

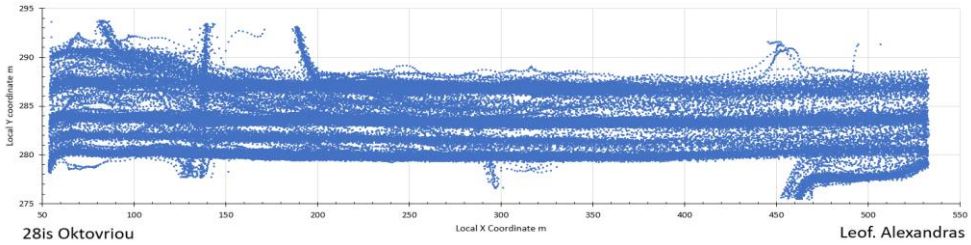


(a) Map of the study area (b) Data points over the study area

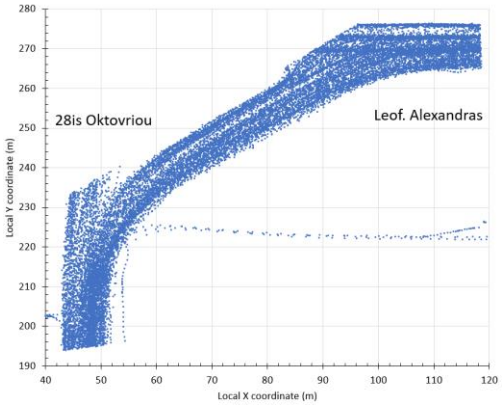
Figure 2 Map and data points over the study area

Identifying the study sections

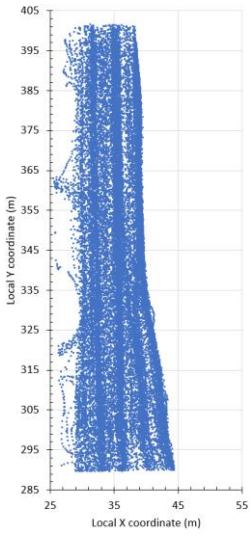
With the help of the image provided by the competition organizers, all three segments are marked. Based on the mathematical geometrics[2], only the study segments trajectory data is extracted. While performing the analysis, it is identified that the study area's plan is inclined at an angle of approximately 11.8 degrees. With the help of coordinate transformation, the axes are rotated, and the three segments data is extracted, as shown in the figure. It can be noted that the coordinates in figure 3 only act as reference coordinates for each segment individually.



(a) Section 1: Leof. Alexandras, with direction towards 28is Oktovriou



(b) Section 2: 28is Oktovriou, with direction towards Leof. Alexandras

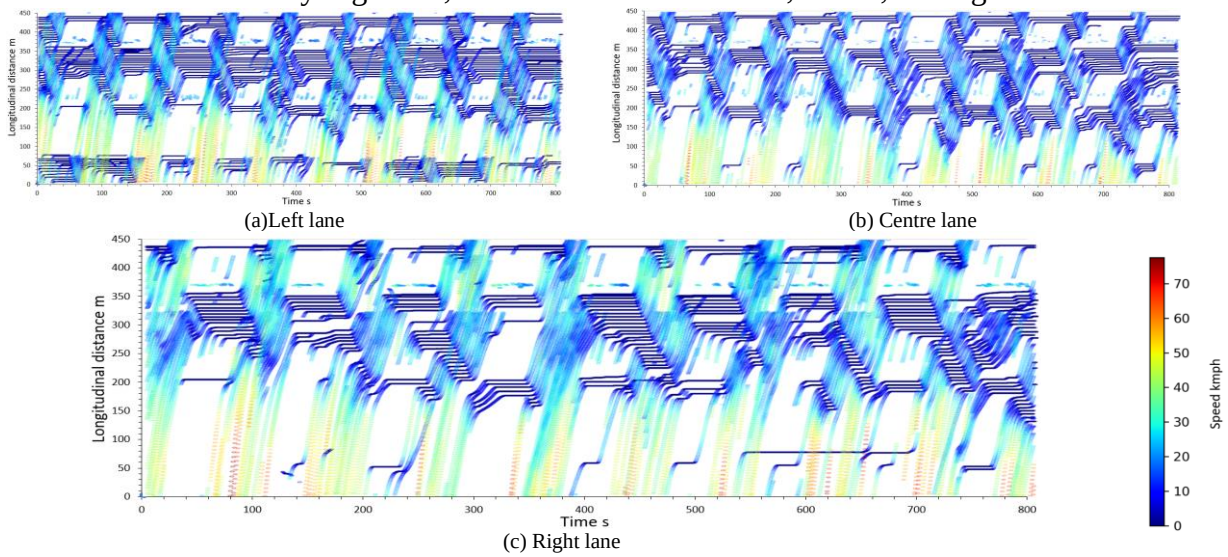


(c) section 3: 28is Oktovriou, above Leof. Alexandras with direction towards the South

Figure 3 Trajectory data points over the three study segments

Sample time space plots

In the present competition, numerous traffic queueing metrics are asked to find out from the trajectory data. Simultaneously, to evaluate the required queuing parameters, the trajectory data from the study sections must be visualised appropriately. In this direction, the time-space plots in traffic engineering are proven to demonstrate the space-time phenomenon of vehicles in the given road space. Considering this, initially, the study segments' trajectory data is divided based on lanes, and the time-space plots of the vehicles are plotted. In depicting this, a sample time-space plot over the lanes from segment 1 is presented in Figure 4. Based on the vehicle movement over the study segments, lanes are classified as left, centre, and right lanes.



(a)Left lane (b) Centre lane

(c) Right lane

Figure 4 Time space plots of the vehicles over the lanes from section 1

Analysis and Results

With the help of time-space plots, necessary critical time stamps and vehicle coordinates are recognized. Further to have a good coincidence on the results (such as queue lengths), the original latitudes and longitudes are identified. Based on this, the quizzed queuing metrics are evaluated, as reported in Table 1.

Table 1 traffic queuing metrics from the study segments

Parameter	Section 1 (Red)	Section 2 (Yellow)	Section 3 (Green)
Maximum length of queue,	200m	68 m	87 m
Lane the maximum length occurred	Centre lane	It is somewhat mixed	Left lane
Coordinates of the start and end of the maximum queue (latitude, longitude)	Start - 37.991613, 23.732583 End - 37.991259, 23.734804	Start - 37.991571, 23.7321 End- 37.991403, 23.731386	Start - 37.991921, 23.73134 End - 37.992688, 23.73151
Timestamp of the maximum queue occurrence,	Start - 400.4 s End- 492.4 s	Start- 663.2 s End – 702.8 s	Start - 290 s End - 362.4 s
whether, when and where a spillback is formed (when applicable).	Time - 446.8 s	Time – 688.8 s	Time – 341.6

References

1 Lippus J. Transformation of coordinates using piecewise conformal mapping. *J Geod* 2004. doi:10.1007/s00190-003-0364-z.

2 Meijster A, Roerdink JBTM, Hesselink WH. A General Algorithm for Computing Distance Transforms in Linear Time. In: *Mathematical Morphology and its Applications to Image and Signal Processing*. 2005 doi:10.1007/0-306-47025-x_36.