Identifying Lane Congestion from non-Lane Resolutive DataTitle

Master‘s Thesis of Wilson Mensah Okang

Mentoring:
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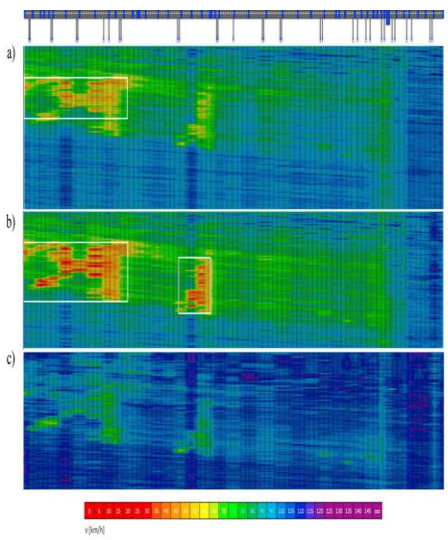

Figure 1: Contour plots of A12 freeway: all lanes (a), lane 1 (b), and lane 2(c). (Bursa et al., 2019)

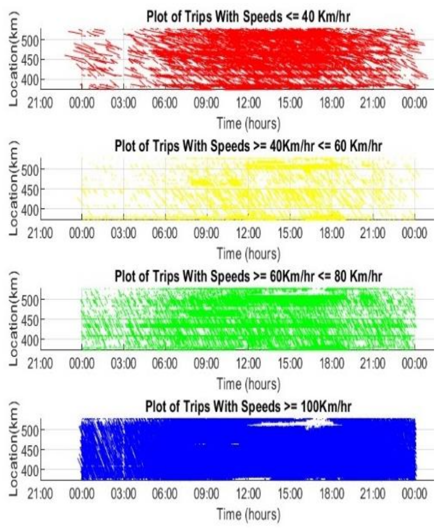

Figure 2: Traffic data by speed levels on the A9

Background and purpose of research

Various traffic data acquisition technology and methods exits, amongst which Bluetooth technology has proven to be relatively cheaper while providing similar accuracy as the traditional methods of traffic data acquisition (Kessler, 2021).

(Kessler, 2021) and (Bursa et al., 2019) revealed in their studies that congestion may occur on a freeway but do not affect all lanes equally. This phenominom is the so-called lane jam. Figure 1 and Figure 2 shows the contrast between lane based studies and aggregated traffic studies. The traditional approach to investigate this would be by, lane by lane trafic data. However, to use Bluetooth technology for this investigation presents a chalenge of detecting lane jams from a non-lane resolute data, due to the working principle of the technology. The aim of this study is to propose an algorithm to detect lane jams from Bluetooth data (non-lane based).

Methodology

The study location and data collection setup for the secondary data acquisition are shown in Figure 3. To achieve the stated aim of this study a lane jam detection algorithm is proposed (Figure 4), implemented, evaluate and optimized while comparing the results to the results of a similar studies based on loop detector data of the same A9 section and time period.

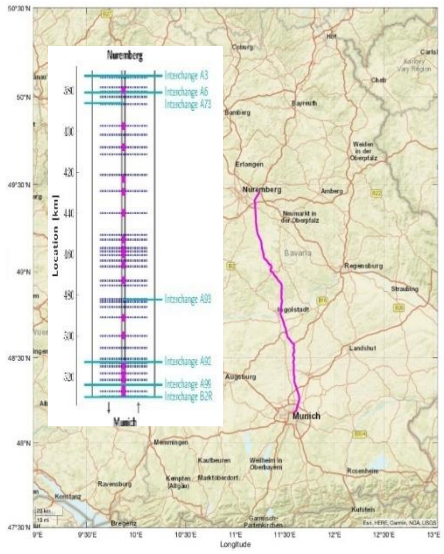

Figure 3: A9 freeway and Bluetooth detector setup (Kessler, 2021)

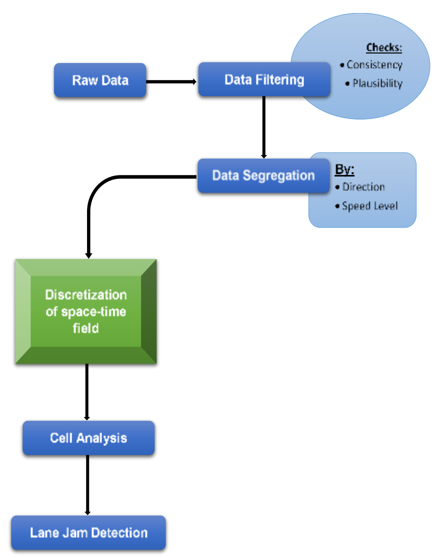

Figure 4: Proposed algorithm

The critical aspect of the algorithm is the lane jam detection process which is based on the percentage of trips with velocities below 40km/hr (J_t) for every discretized cell in a space-time field of the A9. A series of sensitivity analysis was conducted to investigate the effects of varying the parameters for the lane jam detection.

Results: As outcome, it is recommended that the parameter settings in Figure 5 be used in the lane jam detection. Also, a discretized cell size of 2km/hr, cell filtering cut-off value of 25 vehicles and a minimum congested area of 12km/min are recommended

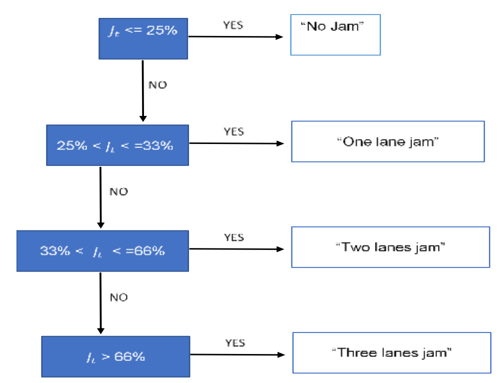

Figure 5: Lane jam detection criteria

Comparative assessment

The assessment showed that the proposed algorithm effectively detected lane jams as detected in the other studies. However, further studies are recommend to investigate some slight variations in the number of lane jams detected, the sizes and the start times/ locations of the jams. A sample of the output jam contour plot is shown in Figure 6 based on the recommended settings. The jam type definitions are presented in Table 1.

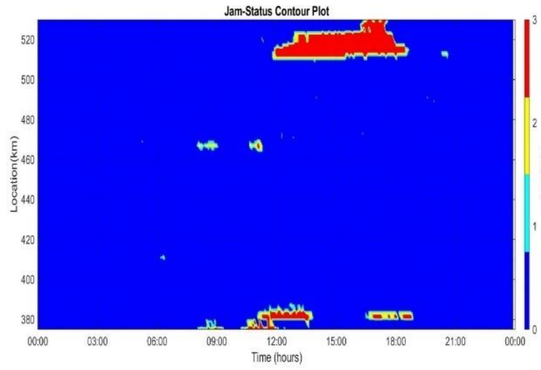

Figure 6: Jam contour plot (using recommend-ded settings)

Table 1: Jam type definitions

Jam Status	Jam Type
free flow condition or low traffic density	0
One lane jammed	1
Two lanes jammed	2
Three lanes jammed	3

Conclusion

This study has demonstrated the capability of the proposed algorithm to detect lane jams from non-lane based traffic data. Additionally, it is strongly recommended that a high threshold value for detecting “No Jam” status combined with a cell filtering (low density cells with fewer slow-moving vehicles) threshold value between 10 and 15 vehicles are very effective in eliminating false alarms.

Refference

Kessler, L. (2021). Strategies for Detection of Congestion Patterns Using Multiple Sensor Technologies [Dissertation, Technische Universität München]. http://nbn-resolving.de/urn/resolver.pl?urn:nbn:de:bvb:91-diss-20211203-1612071-1-1

Bursa, B., Gajic, N., & Mailer, M. (2019). Insights into the congestion patterns on alpine motorways based on separate traffic lane analysis. Transportation Research Procedia, 37, 441-448. https://doi.org/https://doi.org/10.1016/j.trpro.2018.12.220