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Processing quality report reading guide

1. Introduction

One of the deliverables of traffic measurements with DataTubes is a processing quality report. DataTubes are stand-alone detectors that are used as a cluster for measuring traffic. During the measurement there is no communication or such between the detectors so each is fully independent. At the end of the measurement the data captured by each DataTube is processed and combined in to traffic measurements.

By analyzing the data provided by each DataTube in the cluster and some key traffic parameters the quality of the source data and processing algorithms can be validated.

Just like any other measurement system, also the DataTube isn't perfect. With this quality report the customer can judge the quality and temporary drops in performance. Active Roads uses the same report to find the cases where performance can be further improved.

The quality report is an automatically generated document that contains graphs without any explanation. For all systems there are locations and moments where measurements are performed perfectly but under some conditions that may only appear for a few hours performance may drop. For this reason the document contains data for the entire measurement period as well for each day and each lane.

Processing of the raw data can be divided into a number of independent steps:

- Reconstructing an very accurate clock for each DataTube
- Build a list of all vehicle detections per DataTube individually (course events)
- Merge course events for all DataTubes per cluster into 'traffic events'
- Analyze each 'traffic event' to determine speed, vehicle length and optionally type

Some graphs are 100% black box: they are fully independent of the type of measurement and could also be used for other traffic detectors for comparison. The data they show is bases on the final traffic measured. Other graphs are based on key performance indicators that are reported during processing. These key performance indicators are based on comparing the results of the different steps mentioned above.

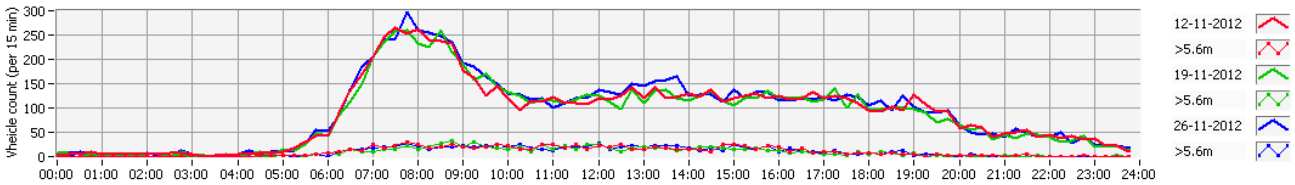
This document is a reading guide to interpret these graphs and assure that the measurement has been executed up to standard and find any moments where the performance was less then ideal.

More details on traffic measurements with DataTubes and the processing can be found in "Operational principle of DataTubes for traffic measurements.pdf"

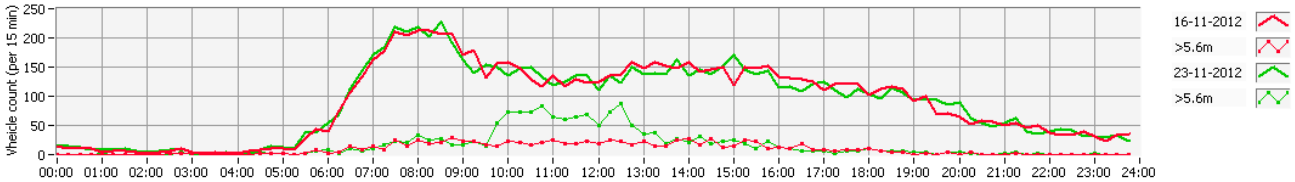
2. 5.6m length split graph

The length split graph is a black box quality graph that is based on final results and can also be done for other detector types. The graph shows the measured intensity per 15 minutes for each day of the week. All weekdays are plot in the same graph.

Per day 2 lines are plotted: the total number of vehicles and the number of vehicles longer then 5.6m.

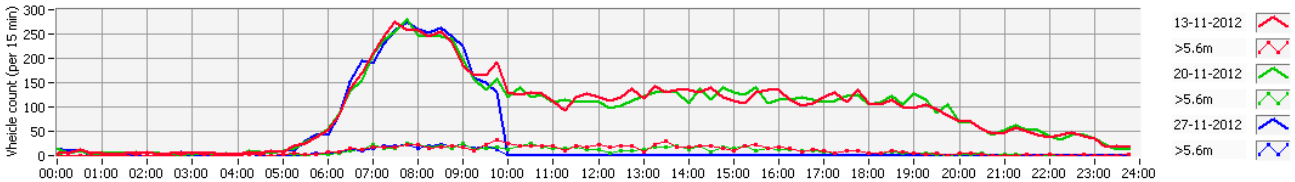


The graph above shows a typical perfect result. The graph shows 3 colors so the data is measured for 3 days. For normal traffic conditions the intensities will be roughly the same so the lines should overlap. If they do deviate from each other, this can be caused by actual traffic volume or an indication that there is something wrong with the measurement.



Nearly all passenger cars are shorter then 5.6m while all busses and trucks are longer. These typically only represent a small portion of the traffic volume. For each day also the number of vehicles longer then 5.6m is plot. If everything is fine this should be a line somewhere in the bottom of the graph.

In the example above there is clearly something happening at 23-11-2012. The total traffic volume is typical, however the amount of long vehicles detected is high. This is an indication that the length detection has a problem at this moment.



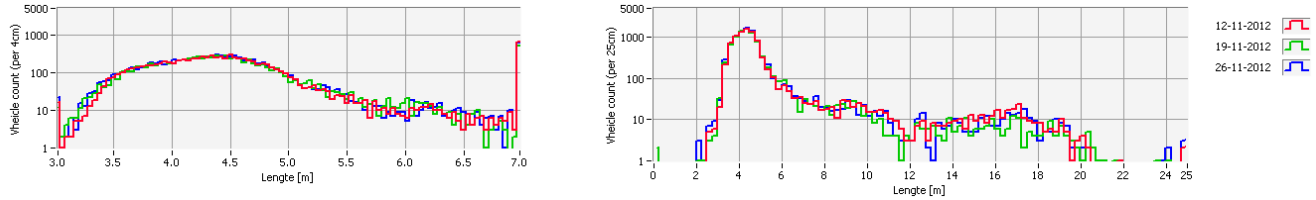
The graph above shows a strange effect in the blue line. This is however a normal case: the measurement for 27-11-2012 stops at 10:00.

3. Length histogram

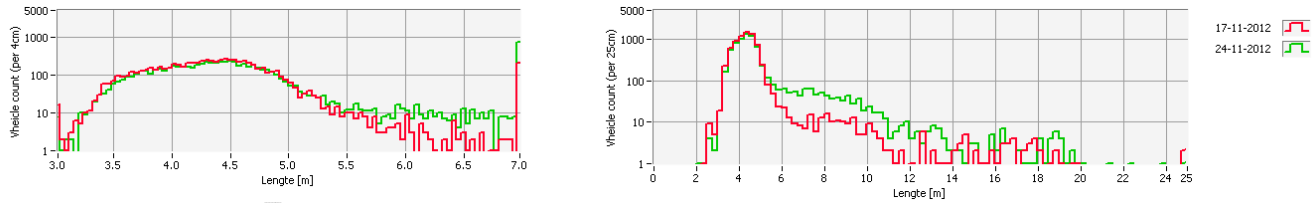
The length split graph is a black box quality graph that is based on final results and can also be done for other detector types. The histogram is split into two graphs where all detected vehicles are plot by a length bin. The vertical axis is logarithmic to give a good representation of all vehicle types.

The left graph is dedicated for passenger car sized vehicles and has a bin size of 4cm. The right graph is for all vehicle types and has a length bin of 25cm.

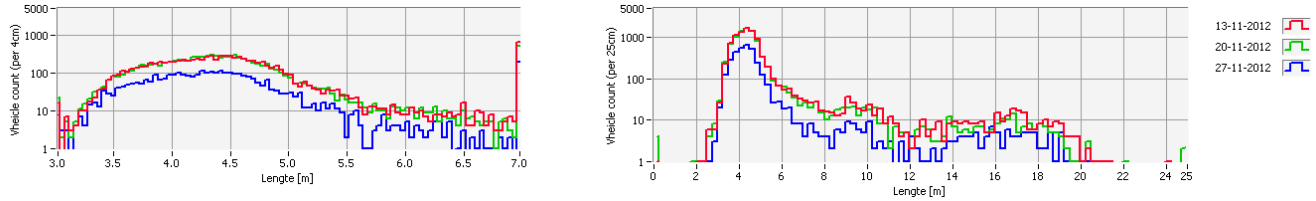
Just as with the '5.6m length split graph' the data is plot per weekday. The main purpose for these graphs is to determine the length is measured accurately and has no drift during the measurement. The clock of the DataTubes could drift outside the accurate region after which the detected speed would get an error. As length is calculated based on speed this would also result in a drift of vehicle length. Of course it can be expected that the vehicle length distribution at a certain location will not change.



The graph above shows an ideal case: The graphs line up and no drift and even the distribution of long vehicles remains the same.



The graph above shows that for 24-11-2012 the accuracy of the system is still good: the peak didn't move. However the tail for vehicles in the range 6-10m has increased a factor 10. This is a sign of an issue with the measurement.



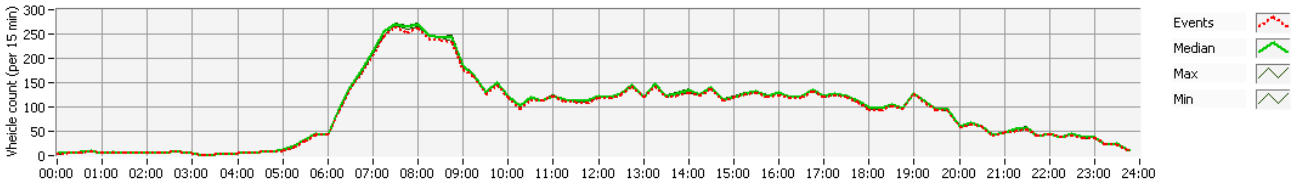
The final graph shows a blue line that is lower then the typical lines. This is good as this again is the day that the measurement was stopped at 10:00 so the total intensity an thus the count per bin was less.

4. Course event ratio

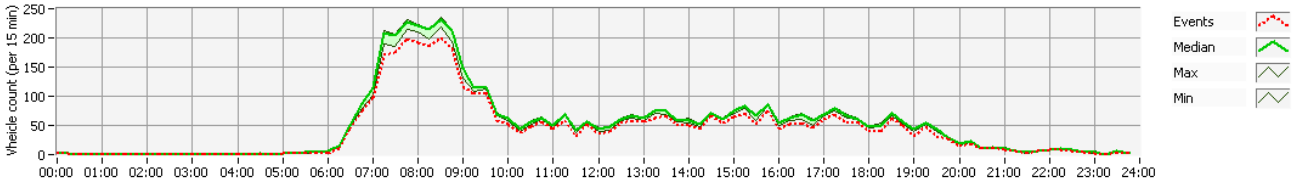
The course event ratio graphs are specific for DataTube measurements. Traffic measurements are done with a cluster of fully independent detectors. One of the first steps during processing is to generate a list of detected vehicles per DataTube. These individual detections are then combined into traffic events for the whole cluster.

In the ideal case the number of detections per DataTube in the cluster (course events) is the same for all DataTubes *and* the same for all traffic events reported after processing. In reality each detector will have false positives (vehicle not detected), false negatives (detection registered but there was no vehicle), combined detections (vehicles close to each other become one detection), split detections (single vehicle becomes multiple detections) and even missed detections (vehicle passes only over some DataTubes in the cluster).

As a result each DataTube will have a slightly different number of course events and the reported traffic events may also be different. The closer these counts are together, the more accurate the measurement.



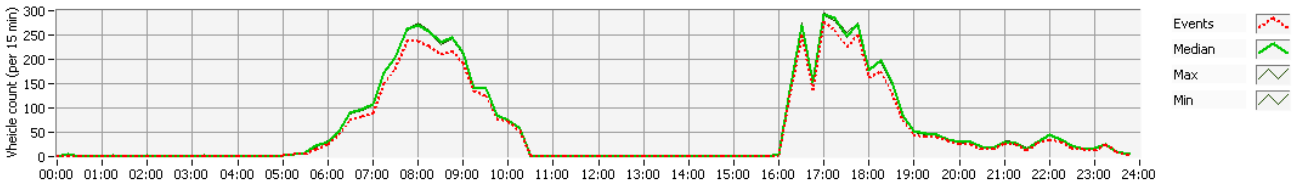
The graph above shows an ideal case. The course events are plot as a band (min/max) and there median (most common count). The traffic events are plot as a dashed red line on top of this. As can be seen all lines overlap so the intensities are very accurate.



The second graph shows a situation that is a little less accurate, especially between 7:00 and 9:00. The band between minimum and maximum number of course event counts can be seen. The median for course events is in the top and not in the middle of the band so this indicates that probably one detector report less course events.

The red-dashed line that is the number of traffic events in the final data is even less then the median (about 85%). This indicates that for this period the reported intensity is likely to be 85% of the actual situation.

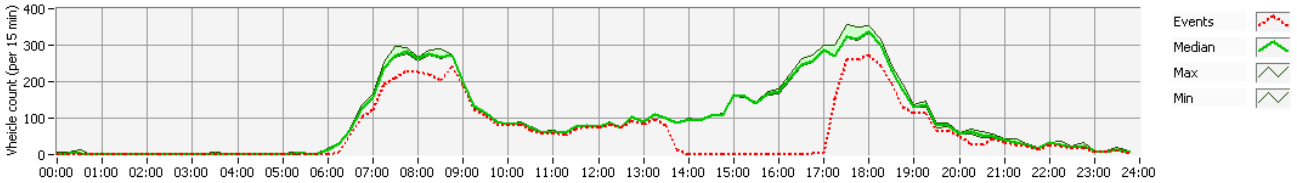
This example shows how Active Roads uses the quality report to find issues and validates improvements. It is clear that the reported number of traffic is less then the actual case. As the DataTubes store raw sensor data the detection of course events can be improved (so the one that reports to little is correct). It is also possible to improve the traffic event detection algorithm so that it can handle a low-performing cluster better, so the red line matches the median.



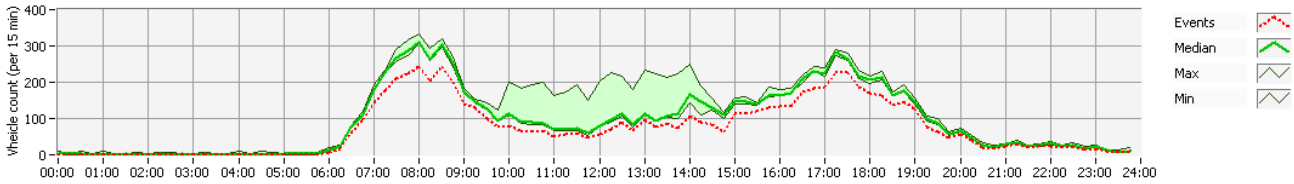
During a survey there may be cases where no traffic is detected for a certain period. This can be caused by a bad measurement or it can be the actual situation. These graphs quickly show what the case is.

As the DataTubes are fully independent, even a complete malfunction of one will not have any effect on the others. The same is true for the detection of course events. In the graph above the red line shows that no vehicles are reported. The course events also have dropped to nothing so this is caused by having no traffic indeed.

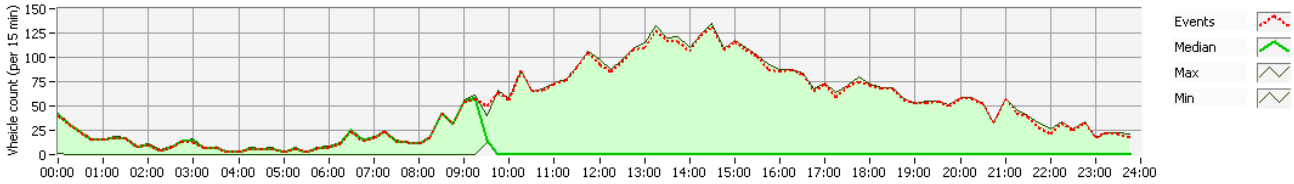
In this case the measurement was done at a 2 lane/direction situation. In the '5.6m length split' graphs it could be seen that the missing vehicles are now travelling at the other lane.



It could also be that something is wrong with one DataTube or with the processing algorithm. Such a case is visible in the graph above. The red line drops to nothing while the number of course events is as expected.



A similar thing can happen with the course event detection. The graph above shows a wide green band from 10:00 till 14:00. The median remains low. This indicated that one DataTube generates many false positives.



Finally there are some cases where the entire bottom part of the graph is filled with a green band. This is a small bug in the reporting software that happens when the cluster definition changes. As this only happens a few times this is ignored for now.