BITS
Bicycles and Intelligent Transport Systems

Evaluation report

Bicycle Path Surface Analysis

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Short description

The province of Antwerp measures the quality of cycle path surfaces with a measuring bicycle. The Flemish government uses a profilometer. This evaluation of cycle path quality leads to the construction of higher quality cycle paths, which then attract more cyclists. Both the surface quality and sufficient width increase the comfort of cycling and the safety for cyclists. The present pilot aims to make the measurement of the surface quality more efficient by evaluating 3 systems : Comfortbike (meetfiets), FPP (Bike Path Profilometer) and Drivenby. This pilot may lead to an international standard for cycle path surface quality measurements.

Type of ITS

Data collection

Hypothesis

Counters have already shown that better quality cycle path surfaces contribute to an overall increase of cyclists. If we can combine measuring techniques, we can follow up much faster and more efficiently on the quality of cycle paths. This in turn will lead to faster improvement of cycle path quality and an increase in cycling.

Data sources

Data	Source	Available
Comfort bike data	*Excel*	*yes*
Profilometer	*Excel*	*yes*
Drivenby	*Excel*	*yes*
Comparative	*Excel*	*partly*

Analysis

Report of the pilot

Technology

Three different mobile devices have been used on five different road sections that are located in the Province of Antwerp in Belgium. The devices are shown below.

Measuring technologies. a A profilometer. b Comfortbike. c Drivenby. Images by Belgian Road Research Center.

All three devices have in common that they measure the road surface conditions of bike paths by using an accelerometer. These devices are the FPP (Fietspad Profilometer, Bike Path Profilometer), a tool used by the Flemish Region, the Comfortbike (meetfiets), which has been developed by the interest group 'Fietsersbond', and the device from Drivenby, which is a commercially developed tool. In the case of the FPP, a scooter with a trailer detects the surface condition. The trailer integrates a laser and an acceleration sensor that measures the distance from the trailer to the surface every three seconds. The GPS location and the number of kilometers were also be detected.

Methodology of the evaluation

The road sections are between 500 and 800 meters long and have different road surfaces of variable quality and materials: Concrete, concrete slaps, concrete tiles and asphalt. All sections are in the Province of Antwerp. The measurements all started at the orange marks that have been painted on the ground to ensure a comparable starting point. The measurements of the FPP and the one from Drivenby also ended on the orange marks of the end point. All devices record quality measurements for the road surface continuously and compute an average value for all 12.5 meters. The FPP and the device from Drivenby calculate the 12.5 meters by directly using the GPS coordinates, whereas the Comfortbike calculates an average of the measured values every three seconds and does a postprocessing after the ride. Within this post-processing the GPS coordinates from the start point and from the end point are used. The measurements have been done by the Belgian Road Research Center (BRRC). Every device measured each road section twice. All measurements were collected on the same day (19th of July 2021).

Objective

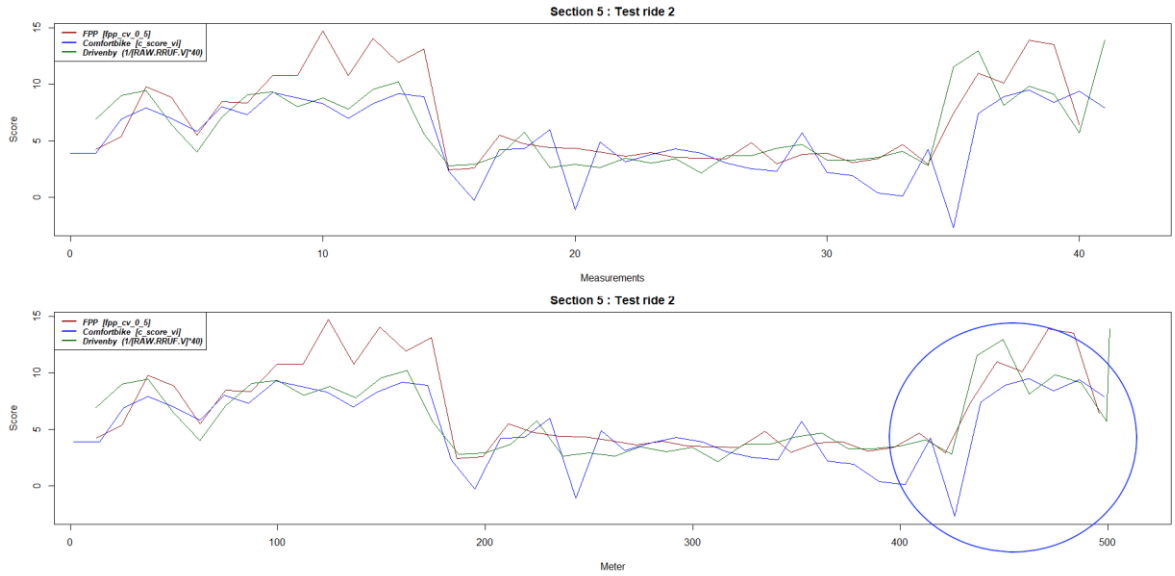
The objective of this pilot is the analysis of the reliability of the measurements and an investigation which of two different forms of presentation is better for comparing measurements. The findings of this work are important for the question if it is appropriate to transform data from different devices into one scale. This is the case only when the measurements of the different devices can be visualized in a precise way on the x-axis and when the measurements are reliable.

Results

The FPP has always recorded one measurement more than the expected number. The expected number of measurements is hereby the total length of the test section divided by the 12.5-meter interval. The measurements of the Comfortbike vary between two and four more calculated measurements. The device

from Drivenby mostly created the expected number of measurements, beside some trips, where one measurement more has been computed.

The figure below shows the comparison of the measurements between the different devices. Regarding the reliability of the measurements the FPP and the device from Drivenby show the best results. Most of the diagrams of the FPP and the device from Drivenby that compare the two test rides at the same section show two quite similar graphs. The reliability of the measurements for the Comfortbike exists, when the ranges and the distribution of the values are considered. With reference to the number of measurements and the length of the GPS tracks the device from Drivenby has the best results regarding the expected values.



Comparison of the measurements between the different devices: Section 5, Test ride 2. a Measurements in sequence. b GPS distance

For both technologies, the FPP and the device of Drivenby, the two presentation forms are equally good when the measurements of the same technology are investigated. However, when comparing the three technologies, FPP, Comfortbike and Drivenby, the GPS coordinates that are stored with each measurement should be used to calculate the distances from the start point. By doing this, the measurements often fit better, especially for measurements that are taken further away from the starting point.

Impact

While the comparison of different systems to measure bicycle path surface quality in itself will not directly lead to increased bicycle uptake and CO2 reduction, it will lead to more efficient ways to collect data and inform policy on where surface quality is substandard and may fuel efforts to systematically improve quality of bicycle infrastructure (of which high quality bicycle paths is an important part). Such efforts may increase cycling comfort which leads to increased cycling.

An exercise was made to hypothesize the potential increase of cyclists due to increase the quality of the bicycle infrastructure. Especially the surface conditions are very relevant for cycling comfort and frequent

bicycle use. Using the BITS survey data of all Antwerp respondents, we can make some statements concerning the potential impact of better bicycle infrastructure.

23% of the respondents of the province of Antwerp indicated that the 'lack of appropriate cycling infrastructure' prevented them from cycling while 10.9% indicated that they would cycle more 'if there would be appropriate cycling infrastructure'. These numbers do not substantially differ when taking a look at the people who would like to cycle a lot more to go shopping or to see family or friends to commute or as a leisure activity in itself .

If we assume that all people with the intention to cycle more, also would transform this intention into action, we can make the following assumptions.

12.7% of all respondents have a high willingness to cycle a lot more (for shopping, travel to leisure activities, day care centre of to see family or friends), 11.4% to commute and 11.2% as a sport or a leisure activity in itself.

When we only take the people with a **willingness to cycle** 'a lot more' into consideration for any of these activities and we look at the number of those for who 'appropriate cycle infrastructure' is a barrier or indicate 'that they would cycle more if appropriate cycle infrastructure was in place' then the number of cyclists that could theoretically increase with 2.16%. If we add the group with a willingness to cycle 'more', there would be a potential of a 4.36% increase.

Obviously, these numbers are theoretical and an immediate increase of 2 to 4% cyclists should not be expected as people who indicate their willingness to cycle will not always translate that willingness into action on the bicycle immediately. In addition, in reality any increase in cycling will depend on changes with respect to several barriers simultaneously. However, it gives some indications on the impact of appropriate bicycle infrastructure.

Experiences project managers

The project managers were in general satisfied with the results of the data and stressed the good collaboration between Province of Antwerp and Oldenburg.

- Data allowed for a good comparison of the different systems. From five different test streets three different vehicles measured the street segments twice. Because of close contact between the analysts and the people who did the test run, deeper information on the comparability of and the methodology behind the systems could be collected. This knowledge helped to create algorithms that transformed the data of the different devices to a scale on which actual comparisons were possible. The advantage is, that measurements do not have to be repeated only because they have been measured by a different technology.
- The different technologies can be compatible, many lessons learnt towards precision of location and surface quality measurements. The added value for the Province of Antwerp was that the pilot allowed for an inclusion of different quality measurements in one view/map/dashboard

- The precision of GPS coordinates and how they were collected or defined by a reprocessing of collected data is relevant for the precision of location between the different technologies. This obviously also has an effect to the comparability of the quality measurements since their location definition is not necessarily the same.
- Some of the raw data were not made available since they are the most essential element in these patents/technology and could not be released due to economic interests. Raw data is the data in its most basic form, as collected. When these data are processed (aggregated, summarized), for example an average is being calculated for a distance of 12,5m, then you lose details that may have helped in defining a better comparability between the technologies.
- The pilot reached its primary goal: we evaluated the comparability and repeatability of the three technologies. This pilot also led to new knowledge about the measurements of the three technologies, e.g. margins of error of quality and GPS measurements.
- As the measurements have been done all on the same day, it is possible that similar satellites are used for the calculation of the GPS coordinates. With different satellite constellations the results possibly could differ more. It has not been tested to ride the measurement technologies at different speeds and how results are effected when the speed changes within a trip. In this test the devices were ridden in steady speed. This could be further investigated for an even better evaluation of cycle path surface quality measuring technologies.

Conclusions

The pilot met its objective by increasing knowledge on 3 forms of technology that measure bicycle path surface quality. Based on the comparison of the technologies, it can be concluded that the preferred technology (taking budget into account) depends on the goals to be achieved. To join datasets of different technologies into one uniform dataset, more work is needed. This would require a proper conversion algorithm of one dataset to another or to a common standard. We cannot at the moment add a dataset of one technology to a dataset collected by another technology, because the conversion algorithm still needs to be developed.

The pilot did in itself not directly contribute to some of the overall goals of the BITS project as it could not be expected to contribute to increasing numbers of cyclists or a reduction in CO2 emission. However, analysis of the BITS survey indicates that better cycling infrastructure (of which high quality bicycle paths are an important aspect) has the potential to increase cycling.

References

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