

Identification of Accident Location by Use of GPS and Possibilities of its Application

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Abstract

The accurate location of the accident spot is the key for the correct evaluation of a link between road and accident process and for the right choice of improvement measures. Use of GPS offers this desirable level of exactitude and some countries already introduced this tool in a limited scope.

The use of GPS was introduced in the Czech Republic as the standard procedure of the accident registration system since July 1, 2006. As the follow-up the on-line system of visualization of accidents, including all registered parameters for each accidents, was opened for the internal use of traffic police in 2007. In the next phase the system was adapted for wider use of road safety professionals and for open access of wide public. The publicly accessible web site was opened since December 1, 2008 and evoked lively interest of hundred thousands accesses during the first days. The system enables to access each accident described by parameters investigated by police (excluding personal data) and to make own individual selections and summaries according these parameters.

The implementation was based on the results of the pilot project undertaken jointly by Traffic Police and Transport Research Centre. This cooperation, including further applications of the GPS use, demonstrates the efficient way of cooperation between traffic police and road safety research and its contribution in road accidents prevention.

1. Methods of Accident Location

In order to implement the efficient safety measure and to eliminate the concrete faults on the road network or its particular stretch the accurate location of relevant accidents is needed in the first step. The knowledge of the exact distribution of accidents is the key input that enables to identify the safety level of the road network as whole and its individual parts in the next steps.

Each road accident relates to a specific location in road network identified by its road number and by its determination, usually indicated by stationing or by a distance to the fixed objects, like e. g. bridge or crossing in rural areas or by streets and house numbers in urban areas. The information describing accident in a registration form has to be accompanied also by the information describing the relevant road parameters and road equipment in this specific spot. Usually these information are already integrated in a road information system (road databank) operated by road administration. The harmonization of information systems used by traffic police for localization of accidents with information system on road parameters operated by road administration is therefore vital important.

There are three basic methods of accident location identification:

- stationing
- node system
- GPS.

a) stationing

The stationing is the most common method for road location identification. The location is identified by the distance from the zero point of each particular road. The distances are marked by special road signs, usually each 1km, but also small distances like 500m or even 100m are used, depending on the road category and local standards. It often happens that the roads of the local importance and urban roads are lacking this marking what causes subsequently serious difficulties in the identifications of accidents location. But also the distances between stationing signs higher than 200m could lead to certain non-accuracy in the identification of the accident spot.

But the significant disadvantage of this system that limits its accuracy is its complicated adaptation to the changes in the length of the road caused by its reconstruction that changes its length, e. g. bypasses or modifications of the alignment. Such changes demand the update of the stationing signs and successive changes in the maps. Therefore a flexible update system reflecting actual changes has to be introduced between road administration and traffic police.

b) node system

The node system is defined as the network of nodes and sections among them. The nodes are usually placed at the junctions and to each of them is attributed the number. The simple network can be displayed as a web with nodes at junctions. Other objects at the road, like bridges, channels, borders, etc., may be also considered as the nodes what can facilitate the localization in the case of long distances between adjacent nodes. The sections are simple linear elements with the exact distance. Each node is connected with at least one other node. The accident location is identified by the distances from the neighboring nodes.

The node system contains usually node numbers, administration unit numbers, municipality numbers, node characteristics, crossing roads numbers and adjacent nodes number. Also other information can be included, e. g. traffic volumes.

The big advantage of the node system is its simplicity of changes in the case of infrastructure changes.

c) GPS

GPS (Global Positioning System) is the most fast, accurate and cheap system of identification of accident locations. This method uses the localization in the geographic coordinates. Its advantages being recognized as GIS (Geographic Information System) are getting widely used.

The method is suitable for safety analysis issues - road accident locations and spots with high accident concentration can be easily identified. Different background maps can be conveniently used. The localization has to be performed at the accident spot right after the accident occurrence. It enables the most precise examination of the accident causes and its circumstances. For this purposes mobile GPS devices having sufficient accuracy to obtain the location data and to transfer them to a PC can be used.

2. Introduction of GPS in the Accident Registration Process by the Czech Police

The extensive reconstruction of the road infrastructure since beginning of nineties of the last century led to the frequent changes in the state of the road network and accelerated the need to harmonize the information systems on road network used by road administration and traffic police.

Originally uniformed system of the localization of road network based on the stationing of roads was replaced already in the beginning of nineties in the road administration responsibility by the node system. The traffic police continued to keep the stationing system that was regularly updated. Furthermore significant changes were introduced in the administration of roads since 2000. The roads of the international and national importance (motorways, expressways and I. class roads) belong under the responsibility of the state organization Roads and Motorways Directorate, the remaining II. class roads (regional) and III. class roads (local) are administrated by regions. The urban roads belong in the responsibility of the relevant municipalities.

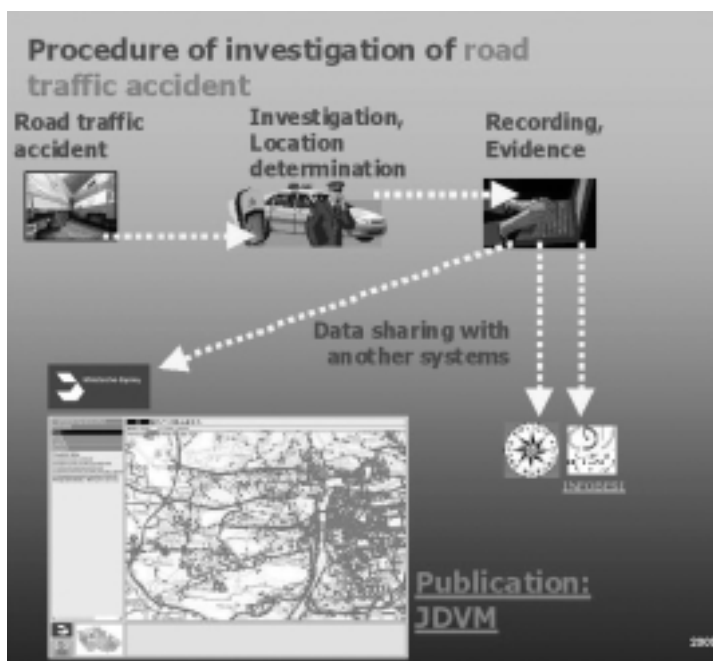
On the other side the governance system of the traffic police didn't change and keeps the former system of administration.

All these aspects influenced not only a complicatedness of the accident registration but also the exactitude of the accident localization. Therefore the "National Road Safety Strategy" approved by the Czech government in April 2004 included among their tasks also the demand to support the precise accident analyses by the introduction of the exact localization of road accidents. The main purpose was to improve and to facilitate the identification of the roads and spots with high accident concentration and to create better preconditions for introduction of road safety audits and road safety inspections. In the same frame formulated traffic police their goals and precised the use of GPS as the only way how to achieve the reliable and accurate registration of road traffic accidents.

This frame initiated the implementation of the joint project of the Ministry of Transport and Traffic Police. The project was elaborated by CDV - Transport Research Center and started in 2004 with the most important phase to prepare the application of GPS in the routine work of traffic police. In the first phase modification of the accident registration system was prepared and tested. Traffic police was equipped with 200 pieces of GPS devices "GEKO 201" and traffic accident police units were instructed.

The use of GPS was introduced in the Czech Republic as the standard procedure of the accident registration system since July 1, 2006.

The system of registration is demonstrated in the scheme as follows.



As the follow-up the on-line system of visualization of accidents, including all registered parameters for each accidents, was opened for the internal use of traffic police in 2007. This system enables to traffic police not only to use the automatically updated information about accident situation and its development in the area of its responsibility but also to streamline their supervision and enforcement activities to the most sensitive areas.

3. Application for Wider Public Use

The last phase of the project was concentrated on the use of the system for the professionals outside of the traffic police. The system is called INFOBESI and offers the sophisticated tool for the efficient solutions of the locations with high concentration of road accidents. The procedure consists of the steps as follows:

- identification of the accident location/s in the selected area or on the selected road according to the defined criteria,
- evaluation of the accidents in the chosen spots and elaboration of the collision diagrams,
- comprehensive assessment of accident circumstances and contributing factors,
- determination of the main causes of accidents,
- proposal for the safety improvement measures,
- estimation of the costs of the proposed measures and of the expected benefits, calculation of the cost benefit ratio,
- ranking of the priorities of the spots to be improved,
- preparation and implementation of the improvement measures,
- monitoring and evaluation.

This phase is tested now, particularly the relevance of the improvement measures and their costs. Since November 2008 accident data are also available for general public access and published in the Geographical Information System "Unified Transport Vector Map" (Jednotná dopravní vektorová mapa - JDVM) of the Ministry of Transport of the Czech Republic operated by CDV - Transport Research Center. The system offers the wide range of the possibilities to represent the accident occurrence in the map according the selection criteria listed below. The criteria can be combined and chosen by the user. Each accident is described by all parameters (excluding personal data) registered by the police in the investigation form. The information can be also printed in pdf format.

The selection data include:

- code number of accident
- type of accident
- impairment by alcohol
- visibility
- type of vehicle
- number of involved vehicles
- consequences - killed /heavy injured / slightly injured
- responsibility for accident
- fuel leak
- road number
- name of the community
- time period (date: from / til).

The system offers the information on accidents since January 1, 2007.

The system brings important source of information particularly for the public administration bodies. They can analyze the accident situation in the selected areas by their own and to decide about relevant safety improvement measures. For example the mayors can explore very simply where are the most frequent accident locations in their community, what are the accidents circumstances and their consequences. On the base of this information they can decide together with traffic police and other involved parties about the best solution of their local problems. It is expected that the system will facilitate the introduction of safety measures and the user will receive more information needed for the decision.

Its introduction induced a surprising interest of the public as well. During the first week after its presentation were registered more than half million hits. This high interest doesn't last in this extend in these days, nevertheless in the first 5 months 2009 were registered 1, 6 million hits with almost 50 thousand visitors. Although the web pages are only in Czech almost 30% of visitors were from abroad. Due to the this international interest the English version of the web pages is under preparation.

The address: www.policie.cz.

The detailed instruction how to enter the web page and how to get the relevant information is included in the Annex.

4. Conclusions

The use of GPS for the accident location identification secures the desirable level of accuracy and offers also many possibilities how to better use the information on accident parameters collected by traffic police. Some countries already introduced this tool in a limited scope or they are going to implement it in a near future.

The use of GPS is running in the Czech Republic as the standard procedure of the accident registration system since July 1, 2006. Its implementation was based on the results of the project financed by the Ministry of Transport and undertaken by Transport Research Centre in the close cooperation with traffic police. This cooperation, including further applications of the use of the accident information system for public, demonstrates the efficient way of cooperation between traffic police and road safety research and its contribution to road accidents prevention.

References

- <http://www.policie.cz>
- Tučka, P. et al, 2008. Information systems for decision support in road safety area, Final research project report (in Czech)
- Mikulík, J. et al, 2007. Road accident investigation guideline for road engineers, PIARC, draft
- National Road Safety Strategy, 2004. Ministry of Transport of the Czech Republic.

How to enter the Czech Road Accident Information System based on the GPS use

Web pages: <http://www.policie.cz>

- ▷ choose **Dopravní servis** (Traffic service) on the top selection ledge
- ▷ take the choice **Nehody v mapě ČR** (Accidents in map of CR)
- ▷ open **Nehody v mapě ČR** (Accidents in map of CR)
- ▷ you enter the selection form:

Číslo nehody (code number of accident): indicate the number if you search for the concrete accident

Druh nehody (type of accident): select from

jiny druh nehody ▼

- 0 jiný druh nehody (other type of accident)
- 1 srážka s jedoucím nekoľejovým vozidlem (crash with going non-rail vehicle)
- 2 srážka s vozidlem zaparkovaným, odstaveným (crash with parking or put aside vehicle)
- 3 srážka s pevnou překážkou (crash with solid obstacle)
- 4 srážka s chodcem (crash with pedestrian)
- 5 srážka s lesní zvěří (crash with wild animal)
- 6 srážka s domácím zvířetem (crash with domestic animal)
- 7 srážka s vlakem (crash with train)
- 8 srážka s tramvají (crash with tram)
- 9 havárie (simple crash)

Alkohol(impairment by alcohol): select from

nezjišťováno ▼

- 0 nezjišťováno (not detected)
- 1 ano (yes)
- 2 ne (no)

Viditelnost (visibility): select from

ve dne, viditelnost nezhoršená vlivem povětrnostních podmínek ▼

- 1 ve dne, viditelnost nezhoršená vlivem povětrnostních podmínek (by day - undeteriorated due to weather conditions)
- 2 ve dne, zhoršená viditelnost (svítání, soumrak) (by day - deteriorated (dawn, dusk))
- 3 ve dne, zhoršená viditelnost vlivem povětrnostních podmínek (mlha, sněžení, dešť apod) (by day - deteriorated due to weather conditions (fog, snowfall, rainfall etc.))
- 4 v noci - s veřejným osvětlením, viditelnost nezhoršená vlivem povětrnostních podmínek (at night, with public lighting - undeteriorated due to weather conditions)
- 5 v noci - s veřejným osvětlením, zhoršená viditelnost vlivem povětrnostních podmínek (mlha, sněžení, dešť apod) (at night, with public lighting - deteriorated due to weather conditions (fog, snowfall, rainfall etc.))
- 6 v noci - bez veřejného osvětlení, viditelnost nezhoršena vlivem povětrnostních podmínek (at night, without public lighting - undeteriorated due to weather conditions)

7 v noci - bez veřejného osvětlení, zhoršená viditelnost vlivem povětrnostních podmínek (mlha, sněžení, déšť apod) (at night, without public lighting - deteriorated due to weather conditions (fog, snowfall, rainfall etc.))

Druh vozidla (type of vehicle): select from

- 00 moped (moped)
- 01 malý motocykl (do 50 ccm) (small motorcycle (to 50 ccm))
- 02 motocykl (včetně sidecarů, skútrů apod) (motorcycle (including sidecars, scooters etc.))
- 03 osobní automobil bez přívěsu (passenger car without trailer)
- 04 osobní automobil s přívěsem (passenger car with trailer)
- 05 nákladní automobil (včetně multikáry, autojeřábu, cisterny apod) (lorry (including special vehicle, crane, mixer etc.))
- 06 nákladní automobil s přívěsem (lorry with trailer)
- 07 nákladní automobil s návěsem (lorry with semi-trailer)
- 08 autobus (buses)
- 09 traktor (i s přívěsem) (tractors)
- 10 tramvaj (tramway)
- 11 trolejbus (trolleybuses)
- 12 jiné motorové vozidlo (zemědělské, stavební atd.) (other motor vehicle (agricultural, building etc.))
- 13 jízdní kolo (bicycles)
- 14 povoz, jízda na koni (cart, ride on the horse)
- 15 jiné nemotorové vozidlo (other non-motor vehicles)
- 16 vlak (train)
- 17 nezjištěno, řidič ujel (not found, driver drove away)
- 18 jiný druh vozidla (other category of vehicle)

Počet vozidel (number of involved vehicles): indicate the number

Následek nehody (accident consequences): indicate the number

umrceno osob: těžce zraněno: lehce zraněno:
killed serious injured slight injured

Zavinění nehody (cause of accident): select from

- 0 jiné zavinění (by other fault)
- 1 řidičem motorového vozidla (by motor vehicle driver)
- 2 řidičem nemotorového vozidla (by non-motor vehicle driver)
- 3 chodcem (by pedestrian)
- 4 lesní zvěří, domácím zvířetem (by wild or domestic animal)
- 5 jiným účastníkem silničního provozu (by other road traffic participant)
- 6 závadou komunikace (by road defect)
- 7 technickou závadou vozidla (by technical failure of vehicle)

Únik hmot (fuel leak): select from

0 žádné z uvedených (none from detected)

1 došlo k úniku pohonných hmot, oleje, chladicího media apod (leak of fuels, oil, cooling liquids)

2 došlo k úniku jiných nebezpečných látek - pevných (leak of other dangerous matters - solid)

3 došlo k úniku jiných nebezpečných látek - kapalných (leak of other dangerous matters - liquid)

4 došlo k úniku jiných nebezpečných látek - plyných (leak of other dangerous matters - gaseous)

Číslo silnice (road number): indicate if interested

Obec (municipality): indicate the municipality

Vyhledat obce

Datum (date): indicate

od (since):

DD.MM.YYYY

do (till):

DD.MM.YYYY

▷ after indication of selected features go to Vyhledat (search)

▷ you receive the window:

Nalezené nehody - celkem .. (found accidents- total)

(číslo nehody - datum): (code number of accident - date):

(accidents are identified by numbers and dates)

▷ either click on the accident row:

on the right side you receive red rows with detailed information about accident parameters and the image of the accident spot

▷ or click on the small window below - **vybrat vše** (select all)

on the right side you receive red rows with detailed information and the map of the accident spots