ANALYSIS OF TRAFFIC CONDITIONS BASED ON THE PERCENTAGE OF DRIVERS USING THE INSTRUCTIONS DISPLAYED ON VMS BOARDS

ANALIZA WARUNKÓW RUCHU DROGOWEGO W ZALEŻNOŚCI OD PROCENTOWEGO UDZIAŁU KIEROWCÓW STOSUJĄCYCH SIĘ DO ZALECEŃ WYŚWIETLANYCH NA TABLICACH ZMIENNEJ TREŚCI

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Abstract: The theme of the publication is to show the influence of human factor on traffic conditions during the traffic incident. The publication also depicts the functionality of the model at which the simulation was performed. The model was constructed in the VISSIM and VISUM software also using Visual Basic for Applications – Excel, [8,9]. By coordinating programs VBA and VISSIM was automated turned on or off the incident as well as turned on or off the VMS with information about the proposed of the alternative route. The additional differentiation of the percentage of drivers using the information displayed enabled to compare the data with identical external conditions influencing at traffic. For statistical analysis of data was used statistical program Statgraphics Centurion which made possible to build a model describing the impact of the behavior of drivers on traffic conditions. It is an innovative approach to modeling the impact on traffic conditions accepted by drivers information transmitted on the boards.

Keywords: simulation models, study drivers' reaction, statistical models

Streszczenie: Tematem publikacji jest pokazanie wpływu czynnika ludzkiego na warunki ruchu podczas wystąpienia zdarzenia drogowego związanego z zamknięciem całej szerokości jezdni. Przybliżono również funkcjonalność modelu, na którym została wykonana symulacja. Model został wykonany w programie VISSIM a także przy pomocy programów VISUM i Visual Basic for Applications – Excel, [8,9]. Poprzez skoordynowanie programów VISSIM i VBA zostało zautomatyzowane włączenie lub wyłączenie incydentu w wybranym miejscu a także włączenie lub wyłączenie tablicy zmiennej treści z informacją o proponowanej trasie alternatywnej. Dodatkowe zróżnicowanie procentowego udziału kierowców stosujących się do wyświetlanej informacji umożliwiło porównanie otrzymanych danych przy identycznych warunkach zewnętrznych wpływających na ruch drogowy. Do analizy statystycznej danych wykorzystano program statystyczny Statgraphics Centurion, co pozwoliło na zbudowanie modelu opisującego wpływ zachowania kierowców na warunki ruchu.

Słowa kluczowe: modele symulacyjne, badania reakcji kierowców, modele statystyczne

1. Introduction

Traffic simulation is the mathematical modelling of transportation systems through the application of computer software to better help operate transportation systems, [7]. Traffic simulation models are classified according to discrete and continuous time, state, and space, [3, 6]. Advanced technologies such as Intelligent Transportation Systems provide an opportunity for alleviating the traffic congestion problem but this requires many testing and evaluation, which can be achieved with computer simulation modelling, [2, 4].

The purpose of the simulation model was elaborated to estimate the effect of the percentage of drivers applying to views on the tables of contents of the variable given an alternative route for traffic conditions prevailing on the two nodes of the Tricity ring road. Model, developed in the VISSIM can be useful for administrators of urban roads and national roads to encourage improvements the efficiency of traffic control at the nodes. Customization programs to the prevailing traffic conditions modelled traffic on the ring road section will allow you to use the capacity of urban road intersections and roads. The model results show the importance of cooperation between the managers of the road so that the administrative division did not affect the quality of travel, especially during the occurrence of different types of traffic incidents significantly affecting the traffic, [5].

2. Model

In the model has been used transport network consisting of two nodes on the ring road of Tricity - Node Karwiny and Node Witomino located in Gdynia and the section between the nodes. In the model was analyzed "accident" located halfway between two nodes and the width of the entire road. The accident took place in the direction of the node Witomino, drivers are informed about the incident five minutes after the start of the accident. At the VMS board was given an alternative route. From the data generated in the model were compared to travel time and delays due to traffic obstructions. Data were compared under the same conditions for a different percentage of drivers who use the information displayed on the whiteboard in embodiments, 0%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% of the drivers using the views.

The model was powered on data from Gdynia TRISTAR macromodel for the year 2012 - the peak morning (6: 00-7: 00) made by the Foundation for the Development of Civil Engineering at the request of the company Qumak - Sekom in the PTV Visum. Using VISUM was cut modelled transport network consisting of interstitial area - it is represented by figure 1 by the colour blue has been marked

Ring Road of Tricity, yellow street Chwarznieńska, street Chwaszczyńska red, green are marked switchboards. Then cut network traffic distribution was made. The obtained results made it possible to create the travel matrix to obtain data traffic volumes. Traffic generated by the program Visum replenished the model in Vissim. After the decomposition obtained assumed a 6% share heavy vehicles.

Fig. 1 The portion of net used to model

Made in the VISSIM model shows the current situation on the modelled section of the road in terms of: intensity, driver behaviour, vehicle type structure, intensity of public transport vehicles, has also been adopted in fix time program signalling on the nodes. To the network model have been added additional lights, which are equivalent to the accident - to block the entire width of the roadway when set to manually from within Excel VBA red light on traffic lights, [8, 9].

On the basis of ready-made examples prepared by PTV has been significantly modified code in Visual Basic for Applications, which adds the functionality of the model. Example prepared by PTV contains functionality:

- Run Vissim;
- Read the file with simulation;
- Running the simulation;
- Switching "one step" in the simulation;
- Stop the simulation;
- Deactivating Vissim.

For existing code were added next actuating functions:

- "Enabling / disabling the accident" - the red light on the traffic lights "- which is to replace the lane off, which can be caused by an accident or other random event.
- Determination of the time after which the driver will be informed about "the accident". In the model is specified cell in an Excel spreadsheet where the user is required to enter the time after which the information will be on the VMS board. This data must be entered in the unit of seconds - the model is 5 minutes.
- Start-up information on the VMS board about "the accident". - Tables were placed virtually in places where there are traffic generators. They are responsible for rerouting the some drivers.
- Re-routing by some part of the drivers who comply with the displayed information.
- Determination of the percentage of drivers using the information on the VMS board. In the model is specified cell in an Excel spreadsheet where the user is required to enter it interesting percentage of drivers. This data must be entered in decimal form - in the model from 0% to 100%.

3. Statistical Modelling

Simulation is a part of statistical estimation of environmental models. Statistical methods can be used for the analysis of environmental computer models in particular for planning computer experiments and for modelling and analysis of the uncertainty of model outputs and sensitivity analysis. [1].

The data obtain from the simulation model presented at section 2 (variables Delay k , $k=10, 20, 30, \dots, 90, 100$) was examined statistically using the program Statgraphics. The results are used to construct the dependency model between average time of drivers delay and percent of drivers who used alternative road (Proc). In the model, the different cases for the smooth flow of cars were used, as shown in the model delay of traffic flow, Fig. 2.

Delay model for the smooth movement (Delay N) is shown in the Fig.2 and the parameters of the distributions in the Table 1

Table 1 Fitted Distributions

Laplace	Logistic	Normal
mean = 131,9	mean = 129,281	mean = 128,497
scale = 0,0220228	standard deviation = 61,8741	standard deviation = 66,6317

Fig. 2. Histogram for DelayN and quantile-quantile plot

The equation of the regression model between averages of Delay k variables and Proc, Fig.3, is

$$\text{Average} = 1788.52 - 13.8194 * \text{Proc}$$

There is a statistically significant relationship between Average and proc at the 95.0% confidence level, since the P-value in the ANOVA analysis is less than 0.05. The R-Squared equals 0.98 statistic indicates that the model as fitted explains 98% of the variability in Average. The correlation coefficient equals -0.989969, indicating a relatively strong relationship between the variables.

Fig. 3 Plot of fitted model

The sensitivity analysis technique was used to determine how different values of the Proc variable impacted a Delay k dependent variables under a given set of assumptions. The result are shown at Fig.4

Fig. 4 The influence of percent of drivers who used information (Proc) on density trace for Delay variable.

The possible form of sensitivity analysis is to vary one value in the model (Proc) and examine the impact that the change has on the model's results (Delay). By reporting extensive outputs from sensitivity analysis, we are able to consider a wide range of scenarios and, as such, can increase the level of confidence that we have in the model.

4. Conclusions

- The model in Vissim helped to obtain data which was used in creation of bimodal model. We can distinguish two groups of drivers using and not using the recommendations VMS, which can be used to calculate the distributions of time delays.
- The proposed alternative route has limited bandwidth and transit route is through urban street layout with many intersections with traffic lights.
- Only the cooperation of urban roads administrators and managers of national roads will bring positive results for drivers.
- Through the model shows that the proportion of drivers using the recommendations of the VMS is of great importance for the traffic conditions. It is important to build trust among the drivers to display information.

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