

UDC 656.1

Fuad Dashdamirov^{1*}, Turan Verdiyev²

¹Associate professor, Director of the Institute of Logistics and Transport, Azerbaijan Technical University, pr. H. Javid 25, Baku, Azerbaijan, AZ 1148. ORCID: <https://orcid.org/0000-0003-3781-3542>.

²Doctoral student, research fellow at the Institute of Logistics and Transport, Azerbaijan Technical University, pr. H. Javid 25, Baku, Azerbaijan, AZ 1148. ORCID: <https://orcid.org/0000-0002-9520-5038>.

*Corresponding author: dr.fuad@mail.ru

Study of the influence of coordinated regulation on the traffic flow parameters on intersecting streets

The article studies the nature of changes in traffic flow parameters on the intersecting streets when using coordinated regulation to organize uninterrupted traffic on city highways. The influence of the "green wave" mode on the traffic flow parameters is analyzed. Traffic delays on intersecting streets were compared before and after the implementation of coordinated regulation. Traffic delay values at intersections were determined and analyzed in a comparative manner using the Webster and HCM 2010 methodology and simulation tests. Measurements were carried out based on real values (speed and traffic intensity on sections) taken at 7 intersections of the street network of the city of Baku. For simulation tests, a coordinated regulation model built in the PTV VISSIM program was used. Using the created micromodel, the results of the impact of the implementation of coordinated regulation on traffic delays on main and intersecting streets were tested. The total time losses on the street where the "green wave" is implemented and on intersecting streets were estimated for the options before and after the coordination of traffic light modes. Based on the values determined by all three methods, it was found that after the implementation of coordinated regulation on the main street the delay time of vehicles increases on intersecting streets. The proposed approach can help to evaluate the effectiveness of coordinated regulation in terms of time losses before its implementation on city streets.

Keywords: *coordinated regulation, traffic flow, traffic parameters, delay, intersection, modeling, PTV VISSIM*

Introduction. Traffic jams and delays on city roads are considered the main problems of urban transport infrastructure. The rapid growth in the number of vehicles requires the implementation of various regulatory and organizational measures in cities. Before moving on to constructive solutions, experts often try to solve the problem by optimizing the organization of traffic. One of such solutions is coordinated regulation ("green wave"), which is introduced to ensure the smooth movement of traffic flows on the main streets of the city. In most large cities in the world, this regulation regime has been adopted as one of the main solution tools and is widely used. However, experience shows that the very organization of such regulation is associated with certain problems.

The main consequences that may arise as a result of the introduction of coordinated regulation on the streets include:

- a large loss of time for pedestrians when crossing the road;
- difficulties for cyclists in areas with high speed;

- increased harm to the environment as a result of increased speed and increased emissions;
- increased exhaust emissions due to delays when making a left turn from the opposite side;
- inefficiency for public transport (especially buses) moving in mixed traffic;
- difficulty adapting to changing conditions due to traffic speed and other parameters;
- inefficiency for traffic on an intersecting street at low traffic volumes on the main road;
- reduced opportunities to ensure safety due to reduced driver attention;
- reduced opportunities to ensure the movement of emergency vehicles;
- increased delay time in intersecting directions;
- inefficiency of time saved on movement on the street due to long delays at the last traffic light;
- efficiency only for streets with certain geometric parameters;
- negative impact on the stimulation of mobility solutions that improve the quality of life, such as walking and cycling.

As can be seen, there are certain negative consequences of coordinated regulation on city streets. However, special attention should be paid to delays and congestion caused by traffic flows on intersecting streets.

Analysis recent research and problem statement. Traffic signal coordination on streets is implemented to improve mobility. Lee and Tarko [1] note that this mobility solution does not include safety measures. In their study, the authors used a logarithmic model of short-term crash probability to examine the impact of coordinated traffic flow on highways on side and rear-end collisions. The studies showed that traffic signal coordination has a significant impact on crashes. Reducing the distances between intersections reduces the number of crashes, and a separate right-turn lane reduces the risk of crashes. Yue et al. analyzed the impact of traffic signal coordination on road safety using a model implemented in the PTV VISSIm program [2]. The authors analyzed the number of traffic conflicts on three Nevada highways under different traffic intensities. The studies showed that the introduction of a “green wave” for unsaturated traffic flows can reduce the number of conflicts. However, no significant differences in the number of conflicts are observed in saturated flows. A study of 121 intersections in Ohio assessed the relationship between traffic signal performance (percentage of green signals) and safety using vehicle trajectory data. It was found that a one percent increase in the number of people driving on green lights reduced the number of crashes by 1.12% [3].

An analysis and evaluation of busy signalized intersections in Baghdad was conducted using Synchro 9. The author estimated the reduction in delays on major streets and queues at intersections in front of traffic signals when using coordinated regulation [4].

There is experience in using modeling programs such as Aimsun, SUMO, Paramics and others to analyze, evaluate and optimize traffic management at intersections and streets [5, 6, 7]. Using Anylogic software, it is possible to analyze, evaluate and improve traffic management at intersections of various configurations [8, 9, 10].

Bencat and Janota consider it appropriate to use a hybrid and multi-method approach, given the complexity of the systems being modeled. The Anylogic environment is considered as such a modeling environment. The authors compare the delay time for existing and designed options based on the values of traffic flow intensity taken from the intersection [11].

In the work of Sutanhaya and Putra, a microsimulation approach was applied using VISSIM software. The T-test was used to test the validity of the simulation. The objective of the study is to improve the efficiency of intersections by coordinating traffic lights. In the simulation tests, it was found that after the implementation of coordinated scheduling, the queue length was reduced by 18.52%, delays by 21.41%, and fuel consumption by 5.15% [12].

In their study, Rida and Hasbi propose an algorithm for wireless network architecture that operates according to changing traffic patterns to reduce queues at intersections, create a green wave system and prioritize traffic on low-traffic streets. The authors use SUMO to model the traffic flow [13].

Delays are considered as one of the key metrics in assessing the service level at a signalized intersection. Kumar et al. compared the delays predicted using the HCM2000 methodology at an intersection with the delays predicted theoretically and found that there was no good correlation between the observed and predicted values. Therefore, the authors recommend using the site-based values to measure the service level [14].

There are a number of studies devoted to assessing vehicle delays at signalized intersections. For example, Huang et al. simplified the analytical formula for the case of uniform vehicle arrival distribution and obtained a linear relationship between time and vehicle location [15]. Ramesh and Molugaram proposed an alternative planning method that takes into account parameters such as delay, queue length, and service level at 4 major intersections in Hyderabad city [16]. In a study that measured traffic delays and service levels at each of three intersections in Ilorin, the average delay time at the intersections was determined and modifications to taxi and bus stop locations and parking areas were suggested [17].

Working on a dynamic car equivalent model to optimize delays for heterogeneous traffic flows at a signalized intersection, Roy et al. found that turning vehicles required more space and took longer [18].

As can be seen, the issue of assessing traffic flow parameters, especially delays, on streets intersecting with signalized streets has been understudied.

The purpose and objectives of the study. The main objective of the study is to analyze changes in traffic flow delays on intersecting streets by assessing and analyzing them using various methods when implementing coordinated traffic flow regulation on streets and avenues in order to ensure uninterrupted traffic flow, as well as determining time losses on main and intersecting streets in order to assess the effectiveness of the regulation regime. For this purpose, traffic flow delays at entrances to the main street and intersecting streets on the selected main street of the city were assessed and compared, and a methodology for assessing time losses of vehicles and traffic flow as a whole on the section under consideration was developed.

Materials and methods of research. The main parameters of traffic flows are the speed of traffic flow, hourly traffic intensity and traffic density. The following relationship exists between these three parameters [19]

$$q = kv, \quad (1)$$

where q - traffic intensity, veh/hour;

v - speed, km/hour;

k - is density, veh/km.

The traffic flow parameters under consideration are significantly affected by traffic control on the street, especially delays at controlled intersections. The speed of traffic is reduced due to delays at the entrances to intersections. Since the traffic intensity is generally constant, the traffic density increases.

At intersections controlled by traffic lights, the delay time according to the traditional Webster model is calculated based on the operating mode of the traffic light as follows [20]

$$d = \frac{c(1-\lambda)^2}{2(1-\lambda x)} + \frac{x^2}{2q(1-x)} - 0.65 \left(\frac{c}{q^2} \right)^{1/3} x^{2+5\lambda}, \quad (2)$$

where d - is the average delay time of one vehicle at each entrance, s;

c - is the cycle length, s;

q - is the traffic flow, veh/h;

λ - is the share of the green cycle in the overall phase, %;
 x - is the saturation factor (the ratio of intensity to capacity).

In the formula, the first term is the average delay of vehicles arriving in different distributions, the second term is the delay due to the randomness of vehicles, and the third term is the correction term, the amount included in the model to take into account specific road conditions.

Modified forms of Webster's model have also been used in various studies. [21, 22].

According to the HCM 2010 methodology, the average delay time of each vehicle at intersections controlled by traffic lights is determined as follows [23]

$$d = d_{un} + d_{ovs} + d_{leave}, \quad (3)$$

where d_{un} - is the delays of vehicles arriving with uniform distribution and is determined as follows

$$d_{un} = \frac{0.5C(1-\frac{g}{C})^2}{(1-\frac{g}{C}X)} \frac{(1-P)f_p}{1-\frac{g}{C}}, \quad (4)$$

where X - the ratio of traffic volume and capacity;

C - cycle length, s;

g - is the duration of the green light, s;

f_p - is progression adjustment factor;

d_{ovs} - is the delay under congested traffic conditions and is determined as follows

$$d_{ovs} = 900T \left[(X-1) + \sqrt{(X-1)^2 + \frac{8KIX}{T_c}} \right], \quad (5)$$

where T - is the assesment period;

K - is increment delay factor 0.4-0.5 (0.5 for fixed-time signals for the M/D/1 queuing system);

I - is upstream filtering adjustment factor (1 for an isolated intersection).

d_{lea} - is the delays occurring when leaving the queue before the intersection and is determined as follows

$$d_{leave} = \frac{3600Q_b}{c} - 1800T(1-X), \quad (6)$$

where c - is capacity of intersection approach, veh/h;

Q_b - is the queue length at the beginning of assesment period, veh.

As an alternative to analytical methods for calculating traffic delays, it is possible to propose determination by means of simulation models using computer programs. Simulation models allow one to evaluate the effectiveness of serious design and organizational measures on streets and roads before their implementation. In addition, using these models, one can successfully test various options for improving traffic organization. The fastest and most cost-effective solution to reduce traffic delays is to improve the performance of traffic lights at intersections. The various simulation programs used for

simulating traffic flows, such as SUMO, Aimsun, CORSIM, Paramics, SimTraffic, PTV Vissim, differ somewhat in their functionality [24]. It is noted that PTV Vissim is increasingly used as a modeling tool in studies related to the analysis, evaluation and improvement of traffic flows [25]. PTV Vissim is more suitable for implementing the verification of various solutions, since it has more necessary functions.

Primary data were obtained by live observation on Bakikhanov Street, one of the main transport arteries of Baku, where the coordinated traffic light mode is implemented. In real life, there are serious queues and delays on intersecting streets. For example, in Figure 1 is shown a satellite image of one of the Bakikhanov Street intersections.



Fig. 1. Satellite image of one of the Bakikhanov Street intersections.

In Figure 2 is shown a traffic organization scheme on Bakikhanov Street in Baku.

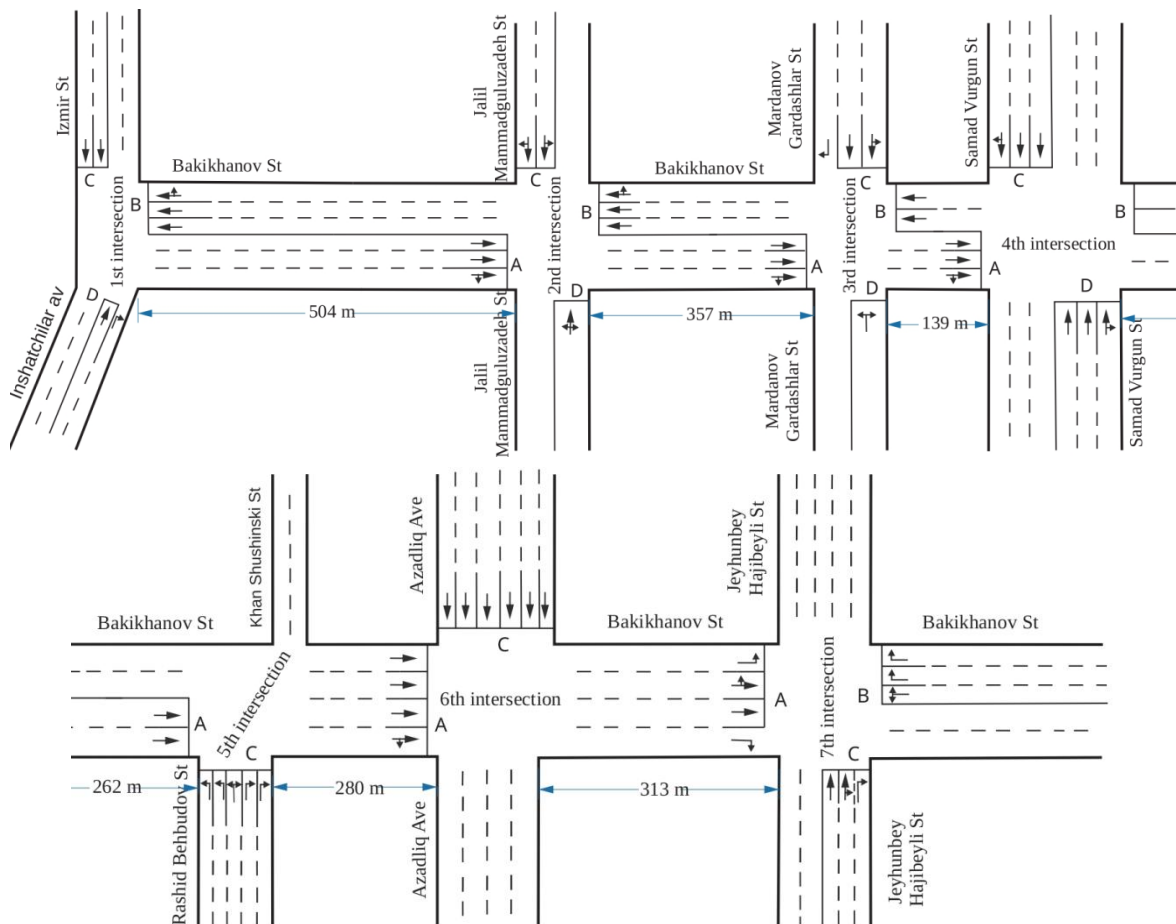


Fig. 2. Traffic management scheme on Bakikhanov Street with traffic directions indicated

intersection with Jeyhun Hajibeyli street) in results of testing of micromodel of traffic, built using the PTV VISSIM program the implementation of coordinated traffic on main street.

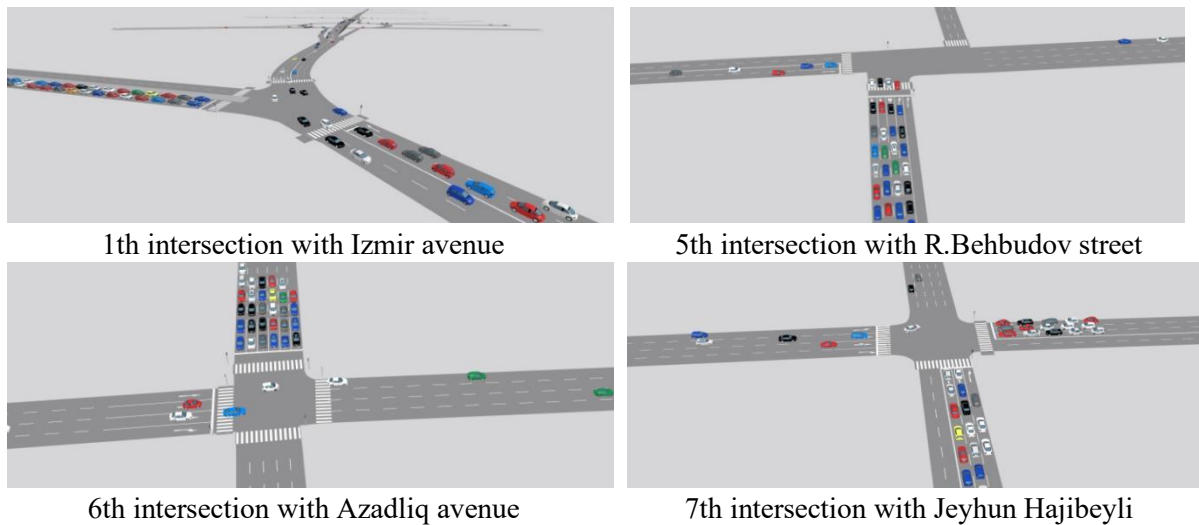


Fig. 4. Queue at intersected direction in results of testing of micromodel (3D)

As can be seen from Figure 4, the results obtained from simulation experiments on streets intersecting with Bakikhanov Street also show that queues are formed in front of traffic lights on the intersecting streets. Therefore, it is necessary to calculate isolated traffic light operation modes based on the actual traffic flow intensities at all intersections and compare the obtained values using the proposed methods.

By applying the proposed simulation model, it is possible to compare the obtained delay time values with those obtained from analytical reports and determine the conditions for the effectiveness of the green wave on the main street in terms of time losses. Based on the above formulas and simulation experiments, a mathematical model was created to determine the total time losses on the street section where coordinated traffic control is applied. Thus, in general, the delay time of entering intersections where coordinated traffic control is applied can be determined as follows in accordance with the Webster and HCM 2010 methodology

$$\sum d = \sum_j^m \sum_{i=1}^n N_{vi} d_i, \tag{7}$$

where d_i - is the vehicle delay time at the stop line i ;

N_{vi} - is the number of vehicles at the stop line i .

The delay time obtained using the model created with PTV VISSIM will be determined as follows:

$$\sum d = \sum_j^m \sum_{i=1}^n D_i, \tag{8}$$

where D_i - is the delay time of all vehicles at the stop line i .

Discussion. The values of delays at the entrances to the intersections of the main and intersecting streets as a result of tests conducted using the model, as well as those calculated using the Webster and

HCM 2010 methodologies before and after the implementation of coordinated regulation at the intersections are given in Table 2 and Table 3.

Table 2. Values of delay time on the main street

	At the 1st intersection	At the 2nd intersection		At the 3rd intersection		At the 4th intersection		At the 5th intersection	At the 6th intersection	At the 7th intersection	
	Delay time per vehicle before the implementation of coordinated regulation, sec										
	B	A	B	A	B	A	B	A	A	A	B
Webster	15.3	13.5	12.8	9.8	10.8	9.7	8.4	11.3	7.2	15.9	31.9
HCM 2010	14.7	12.6	13.2	11.1	9.9	9.7	8.4	10.1	8.1	15.6	37.8
PTV VISSIM	15.8	14.4	12.2	17.3	10.3	10.7	10.7	12.5	9.3	14.9	42.8
	Delay time per vehicle after the implementation of coordinated regulation, sec										
	B	A	B	A	B	A	B	A	A	A	B
Webster	9.9	9.5	9.9	6.9	6.4	7.0	7.3	7.6	6.7	14.9	35.0
HCM 2010	10.1	7.1	7.5	5.7	4.9	6.0	4.9	8.0	7.8	14.7	38.9
PTV VISSIM	12.5	8.7	7.8	11.7	5.1	8.3	4.9	8.2	7.9	14.1	46.7

Table 3. Values of delay time on intersecting streets

	At the 1st intersection		At the 2nd intersection		At the 3rd intersection		At the 4th intersection		At the 5th intersection	At the 6th intersection	At the 7th intersection
	Delay time per vehicle before the implementation of coordinated regulation, sec										
	C	D	C	D	C	D	C	D	C	C	C
Webster	24.7	24.3	19.5	19.9	12.4	11.9	13.8	13.9	23.4	14.1	33.3
HCM 2010	16.1	16.9	19.5	19.2	12.1	12.5	13.9	13.9	24.3	14.6	32.9
PTV VISSIM	18.7	13.1	19.3	20.9	17	10.7	16.8	17	24.6	18.6	34.2
	Delay time per vehicle after the application of coordinated regulation, sec										
	C	D	C	D	C	D	C	D	C	C	C
Webster	28.7	27.9	28.5	28.2	22.5	22.9	23.3	20.3	27.3	17.3	31.8
HCM 2010	22.2	21.1	28.9	28.6	24.9	26.4	24.9	24.8	34.7	28.6	39.7
PTV VISSIM	26.7	18.7	24.3	30.1	31.0	27.6	24.8	27.7	33.5	29.5	42.9

As can be seen from Table 2, the results obtained when calculating traffic delays on the main street using different methods do not differ significantly. However, after the implementation of coordinated regulation on the main street, a decrease in delays was noted. Only at the seventh intersection in the direction B (intersection with J. Hajibeyli), or more precisely at the entrance to Bakikhanov Street, an increase in delays is observed. This is due to the start of the coordinated mode.

Based on the data in Table 3, it can be said that after the implementation of coordinated regulation on intersecting streets with the main street, the average delay time per vehicle increases when calculating using all three methodologies. This increase is felt even more strongly with the growth of the intensity of vehicle traffic in these directions. Delays on intersecting streets are more pronounced at intersections with high intensity and density of traffic. For example, for the sixth intersection in the direction C, the delays per one vehicle, calculated by the Webster, HCM 2010 methodologies and obtained from the simulation experiment in PTV VISSIM for the isolated mode are 14.1, 14.6 and 18.6 seconds,

respectively. But after implementation the coordinated regulation, the delays increase to 17.3, 28.6 and 29.5 seconds, respectively. This is approximately twice as much as the values obtained from the isolated mode of operation.

Using formulas (7) and (8) the results of calculating the total traffic delays on the main highway and intersecting streets, based on the values of Tables 2 and 3, as well as on the values of traffic intensity at intersections, are shown in Table 4.

Table 4. Total delay time at intersections before and after the implementation of coordinated regulation

	Total delay time, hour		
	with Webster methodology	with HCM2010 methodology	with simulation tests
Before the implementation of coordinated regulation	127,2	124,92	139,9
After the implementation of coordinated regulation	128,9	136.25	149,36

As can be seen from Table 4, the total time losses of vehicles when traveling along the main and intersecting streets did not decrease when comparing the variant where isolated regulation was used at intersections with the variant where coordinated regulation was used on the main street. The results obtained during the simulation experiments for considered case show that this time even increases by about 10 hours. From this, it can be concluded that when implementing coordinated regulation on main streets, it is necessary to take into account not only the time losses on this street, but also the time losses on intersecting streets. In this regard, the proposed methodology can be used for verification of effectiveness of coordinated regulation.

Conclusion. In order to reduce vehicle delays on city streets, a coordinated traffic light control mode ("green wave") organizes. Despite its high efficiency on main streets, this solution has certain drawbacks. One of these drawbacks is an increase in traffic delays on intersecting streets.

The calculated values of the delay time using different methods for real traffic light operation modes on streets intersecting with the main street, where coordinated control was used, show that the use of such a mode increases the average delay time on intersecting streets, and in some cases the total delay time on the main and intersecting streets. Therefore, when implementing the "green wave", it is necessary to analyze and verify the total time losses at street intersections using a simulation experiment.

REFERENCES

- Li, W., & Tarko, A. P. (2011). Effect of arterial signal coordination on safety. *Transportation research record*, 2237(1), 51-59. <https://doi.org/10.3141/2237-06>.
- Yue, R., Yang, G., Zheng, Y., Tian, Y., & Tian, Z. (2022). Effects of traffic signal coordination on the safety performance of urban arterials. *Computational Urban Science*, 2(1), 3. <https://doi.org/10.1007/s43762-021-00029-4>.
- Kabir, R., Remias, S. M., Lavrenz, S. M., & Waddell, J. (2021). Assessing the impact of traffic signal performance on crash frequency for signalized intersections along urban arterials: A random parameter modeling approach. *Accident Analysis & Prevention*, 149, 105868. <https://doi.org/10.1016/j.aap.2020.105868>.
- Abdulstaar, Z.A. (2023). Effect of Signal Coordination on The Traffic Operation of Urban Corridor. *Tikrit Journal of Engineering Sciences*, 30(1),12-24. <https://doi.org/10.25130/tjes.30.1.2>.
- Fabian, P., Čulík, K., Kalašová, A., & Černický, E. (2024). The Impact of Road Realignment on the Traffic Load in the Surrounding Area. *Vehicles*, 6(4), 1942-1962. <https://doi.org/10.3390/vehicles6040095>.
- Yu, C., Chen, J., & Xia, G. (2022). Coordinated control of intelligent fuzzy traffic signal based on edge computing distribution. *Sensors*, 22(16), 5953. <https://doi.org/10.3390/s22165953>.
- Rida N., Ouadoud, M., &Hasbi, A. (2020). Coordinated Signal Control System in Urban Road Network. *International journal of Online and biomedical Engineering*, 16(10), 1-19. <https://doi.org/10.3991/ijoe.v16i10.15473>.

8. Liu, Y., & Song, Y. (2022). Research on simulation and optimization of road traffic flow based on Anylogic. In *E3S Web of Conferences* (Vol. 360, p. 01070). EDP Sciences. <https://doi.org/10.1051/e3sconf/202236001070>.
9. Kazmi, S. M. M., Sun, X., Yu, H., Pettersen, J. A., & Thordarson, D. S. (2022). *Proceeding of the 32nd conference of fruct association*. (p. 369-365). <https://fruct.org/publications/volume-32/acm32/>.
10. Dashdamirov, F., Aliyev, A., Verdiyev, T., & Javadli, U. (2023, June). Improving Intersection Traffic Management Solutions by Means of Simulation: Case Study. In *Recent Developments and the New Directions of Research, Foundations, and Applications: Selected Papers of the 8th World Conference on Soft Computing, February 03–05, 2022, Baku, Azerbaijan, Vol. II* (pp. 279-286). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-23476-7_25.
11. Benčat, G., & Janota, A. (2020). Road traffic modelling based on the hybrid modelling tool AnyLogic. *Journal of civil engineering and transport*, 2(2), 73-89. <https://doi.org/10.24136/tren.2020.006>.
12. Suthanaya, P. A., & Putra, R. (2023). Traffic signal coordination based on VISSIM software (case study of Sudirman road in Denpasar city, Indonesia). In *E3S Web of Conferences* (Vol. 445, p. 01004). EDP Sciences. <https://doi.org/10.1051/e3sconf/202344501004>.
13. Rida, N., & Hasbi, A. (2022). A collaborative road traffic regulation approach using a wireless sensor network. *International Journal of Service Science, Management, Engineering, and Technology (IJSSMET)*, 13(1), 1-19. <https://doi.org/10.4018/IJSSMET.290330>.
14. Kumar, R. P., & Dhinakaran, G. (2012). Estimation of delay at signalized intersections for mixed traffic conditions of a developing country. *International journal of civil engineering*, 11(1), 53-59. <http://ijce.iust.ac.ir/article-1-595-en.html>.
15. Huang, J., Li, G., Wang, Q., & Yu, H. (2013, November). Real time delay estimation for signalized intersection using transit vehicle positioning data. In *2013 13th International Conference on ITS Telecommunications (ITST)* (pp. 216-221). IEEE. <https://doi.org/10.1109/ITST.2013.6685548>.
16. Ramesh, A., & Molugaram, K. (2018). Evaluation of delay characteristics at signalized intersections for improvement in level of service. *International journal for traffic and transport engineering*, 8(3), 309-319. [http://dx.doi.org/10.7708/ijtte.2018.8\(3\).05](http://dx.doi.org/10.7708/ijtte.2018.8(3).05).
17. Wasiu, J., Owolabi, A., & Popoola, O. (2015). Determination of Traffic Delay at Selected Intersection within Ilorin Metropolis. *American Journal of Engineering Research (AJER)*, 4(9), 176-180.
18. Roy, B., Suma, S. A., Hadiuzzaman, M. D., Barua, S., & Mashrur, S. K. (2021). Optimization of Delay Time at Signalized Intersections Using Direction-Wise Dynamic PCE Value. *International Journal of Transportation Engineering*, 8(3), 279-298. <https://doi.org/10.22119/ijte.2020.225672.1514>.
19. Knoop, V. L. (2021). *Traffic Flow Theory: An Introduction with Exercises*. TU Delft OPEN Publishing. <https://doi.org/10.5074/t.2021.002>.
20. Webster, F.V. (1958). *Traffic Signal Settings. Department of Scientific and Industrial Research, Road Research Technical Paper No. 39*. Her Majesty's Stationary Office, London, England. <https://trid.trb.org/View/113579>.
21. Hoque, S., & Imran, A. (2007). Modification of Webster's delay formula under non-lane based heterogeneous road traffic condition. *Journal of Civil Engineering*, 35(2), 81-92.
22. Raval, N. G., & Gundaliya, P. J. (2012). Modification of Webster's delay formula using modified saturation flow model for non-lane based heterogeneous traffic condition. *Highway Research Journal*, 5(1), 41-48.
23. Manual, H. C. (2000). Highway capacity manual. *Washington, DC*, 2(1), 26-27. <https://onlinepubs.trb.org/Onlinepubs/tnews/rpo/rpo.trn129.pdf>.
24. Akkaya, S., & Engin, T. (2022). Traffic simulation software overview. *Akıllı Ulaşım Sistemleri ve Uygulamaları Dergisi*, 5(2), 157-168. <https://doi.org/10.51513/jitsa.1090209>. [in Turkish].
25. Qadri, S. S. M., Gökçe, M. A., & Öner, E. (2020). State-of-art review of traffic signal control methods: challenges and opportunities. *European transport research review*, 12, 1-23. <https://doi.org/10.1186/s12544-020-00439-1>.

Фуад Дашдаміров¹, Туран Вердієв²

¹Доцент, директор Інституту Логістики та Транспорту, Азербайджанський Технічний Університет, пр. Г. Джавід, 25, Баку, Азербайджан, AZ 1148. ORCID: <https://orcid.org/0000-0003-3781-3542>.

²Докторант, науковий співробітник Інституту Логістики та Транспорту, Азербайджанський Технічний Університет, пр. Г. Джавід, 25, Баку, Азербайджан, AZ 1148. ORCID: <https://orcid.org/0000-0002-9520-5038>.

Вивчення впливу координованого регулювання на параметри транспортного потоку на вулицях, що перетинаються.

У статті досліджується характер зміни параметрів транспортних потоків на вулицях, що перетинаються, при застосуванні узгодженого регулювання для організації безперебійного руху на міських магістралях. Проаналізовано вплив режиму "Зеленої хвилі" на параметри руху транспортних потоків. Затримки транспортного потоку на вулицях, що перетинаються, порівнювалися до і після впровадження узгодженого регулювання. Значення затримки руху на перехрестях визначалися та аналізувалися порівняно з використанням методології Webster та HCM 2010 та імітаційних тестів. Вимірювання проводилися на основі реальних значень (швидкості та інтенсивності руху на ділянках), взятих на 7 перехрестях вуличної мережі міста Баку. Для імітаційних випробувань використовувалася модель координованого регулювання, побудована у програмі PTV VISSIM. За допомогою створеної мікромоделі перевірено результати впливу впровадження узгодженого регулювання на затримки руху на основних вулицях, що перетинаються. Оцінено сумарні втрати часу на вулиці, де реалізується «зелена хвиля», і на вулицях, що перетинаються, для варіантів до і після узгодження режимів роботи світлофорів. На підставі значень, визначених за всіма трьома методиками, встановлено, що впровадження узгодженого регулювання на вулиці, що розглядається, дозволило скоротити загальні втрати часу. Однак на вулицях, що перетинаються, збільшується час затримок транспортних засобів. Запропонований підхід може допомогти оцінити ефективність координованого регулювання з погляду втрат часу до його впровадження на міських вулицях.

Ключові слова: координоване регулювання, транспортний потік, параметри руху, затримка, перехрестя, моделювання, PTV VISSIM