EVALUATING THE EFFECTIVENESS OF THE ADAPTIVE CONTROL SYSTEM IN BREST REGION

Sergey Anfilets, Vasiliy Shuts

Brest State Technical University, Belarus

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Introduction

Rapid motorization process each year includes a growing number of countries is constantly growing fleet, the number of the affected traffic of people. The growth of vehicle population and traffic volume increases the volume of traffic that, in the cities with historical buildings leads to the transport problem. Most acutely manifested in the nodal points of the road network. This increased traffic delays, queues and congestion, which causes a decrease in speed communications, unwarranted excess fuel consumption and increased wear of components and assemblies of vehicles. Variable mode of motion, frequent stops and congestion of cars at intersections are the causes of increased air pollution in the city products of incomplete combustion of fuel. The urban population is constantly exposed to traffic noise and exhaust gases [1-3].

Arrangements help streamline the traffic on the existing (current) road network. These activities include one-way traffic, roundabouts at intersections, pedestrian crossings and the organization of pedestrian zones, car parks, public transport etc.

At that time, as the organization of activities Architectural and Planning nature requires, in addition to significant investment, quite a large period of time, arrangements can lead albeit temporarily, but the relatively rapid effect, in some cases arrangements act as the sole means to solve the transport problem.

System Description

The current split rigid program control at the intersections of the city is unable to take into account short-term random fluctuations in the number of cars approaching the intersection. If slow change of the traffic the optimal duration of the cycle and phases, calculated for the conditions of the peak period for the rest of the time of day are not optimal, as a rule, are too large, leading to unnecessary delays in transport. In such cases, you must coordinate the implementation of programs oriented to the selection peak periods. Yet such a system of coordinated control will not take into account the random nature of fluctuations in the number of cars approaching the intersection for the same periods of time [4,5].

Adaptive management on a single junction is constant for the determination of optimal data average values of the traffic cycle time and phase regulation, and to adjust these durations in accordance with the instantaneous fluctuations in the number of cars approaching the intersection. This requires the implementation of the level of feedback between the parameters of traffic flow and control actions of the system. The parameters of traffic flow (intensity, velocity, density, length of the queue at an intersection, the presence of vehicles with the right of priority passes, etc.) are recorded by detectors of Transport (DT). The information on the status of traffic flow is handled, and the results are used to control, and can also serve as the basis for the calculation of flow characteristics, which can not be obtained by direct measurement.

Detectors, used in the adaptive control system, designed to detect vehicles and determine the parameters of traffic flow. These data are necessary to implement algorithms flexible regulation, calculation or automatic selection program of traffic management, transport planning.
Each detector consists of three main elements: the sensing element (SE) or block detection and input signal power amplification, conversion, output device (OD).

The sensor element is directly perceive the fact of or the presence of a vehicle in a controlled area of the detector as a change in some physical characteristics and generates a primary signal.

Power converter increases, processes and converts the primary signals to a form suitable for recording the measured parameter of traffic flow and processing of the event. It may consist of two components: primary and secondary converters. Primary converter amplifies and converts the primary signal to a form suitable for further processing. Secondary converter processes the signals to determine the parameters measured flow, presenting them in a physical form. The secondary converter is accomplished by the microprocessor elements. Often in the detectors secondary converter is closely linked or combined with the primary in a single functional site.

Output device is intended for the storage and transmission over dedicated channels in the control point or controller is formed by the detector transport information [5].

Thus, the system is divided into two subsystems in the spatial implementation. Requires a block of DT with SE installed directly at the point of registration of passing vehicles, and a block adaptive system that interacts with the road and the controller controls the operation of remote units with sensitive elements (sensors).

The signal from the unit of analysis phase goes to the central unit of the adaptive system that interacts with road controller, in accordance with this signal, this block generates a request to a remote cluster of DT, which corresponds to the current phase, the request is transmitted through the transceiver on the air. DT with a sensitive element, which is addressed to the request, transmits information from the sensor. The signal comes to the central transceiver unit, this unit is then analyzed and the results of the analysis generated a signal to the executive power, which directly controls the phase. Then the central unit re-examining the phase and the corresponding queries the current phase, the remote unit DT and the process repeats.

Due to the fact that the central unit interrogates sensors in series, the other sensors are transferred to a low power mode.
Using such an automated system for adaptive control motor controlled junctions will solve the following tasks:

– To reduce the time spent before the traffic light transport;

– Reduce the number of road congestion;

– Reduce fuel consumption;

– Reduce the amount of harmful emissions into the atmosphere;

– To keep the service life of the vehicle;

– Reduced noise levels and vibration.

Assessment of efficiency

During 4 years (since 2007) at the Department of Intelligent Information Technologies BrSTU conducted research and development in designing adaptive control system for vehicles in the road network of the city, which has successfully completed a three-month trial (from 1.05 to 31.07.2010) prototype system “Asua Brest 1”, based on the above scheme of implementation. Interaction of the adaptive system and traffic controller, “DUMKA” is carried out through the channel TVP, which provides conflict-free, reliable connection to a running controller and the road does not violate the principles of his work. This prototype system installed and tested in operation in the city of Brest, at the intersection of Republic Prospect - Str. Krushynska (in consultation with the relevant central, regional and urban services).

As a result of the test revealed that the capacity of the above intersection on average increased in 1,6 times. A more detailed breakdown is given in Tables 1–2.

Table 1

Basic data		Number of vehicles in queues				The advantages of adaptive control method in comparison with rigid: by reducing the number of cars in queues	
Direction of traffic by:	The intensity of traffic, vehicles per hour (data obtained from actual observations)	strict management of traffic lights		Adaptive management of traffic lights			
		Max	Avg	Max	Avg	Max	Avg
						col 4 : col 6	col 5 : col 7
Guznyansky bridge	1134	15	6.7	14	4.3	1.1	1.6
Partisan prospect	1080	14	6.1	13	4.0	1.1	1.5
University	260	6	1.8	3	0.7	2	2.6
petrol station "Gallon"	305	7	2.2	4	0.6	1.75	3.7

Table 2

Basic data		Number of vehicles in queues				The advantages of adaptive control method in comparison with rigid: by reducing the number of cars in queues	
Direction of traffic by:	The intensity of traffic, vehicles per hour (data obtained from actual observations)	strict management of traffic lights		Adaptive management of traffic lights			
		Max	Avg	Max	Avg	Max	Avg
						col 4 : col 6	col 5 : col 7
Guznyansky bridge	753	16	4.2	9	2.5	1.8	1.7
Partisan prospect	741	16	4.1	9	2.5	1.8	1.6
University	124	6	0.7	4	0.5	1.5	1.4
petrol station "Gallon"	80	4	0.5	3	0.5	1.3	1

Table 1 shows the results of the processing statistics in the morning from 9 to 11 hours. Table 2 - Results of processing statistics in the evening hours from 19 to 21 hours. Below is a diagram of positives adaptive control system to break in the traffic flow for the period from 29.04.2010 to 03.05.2010.

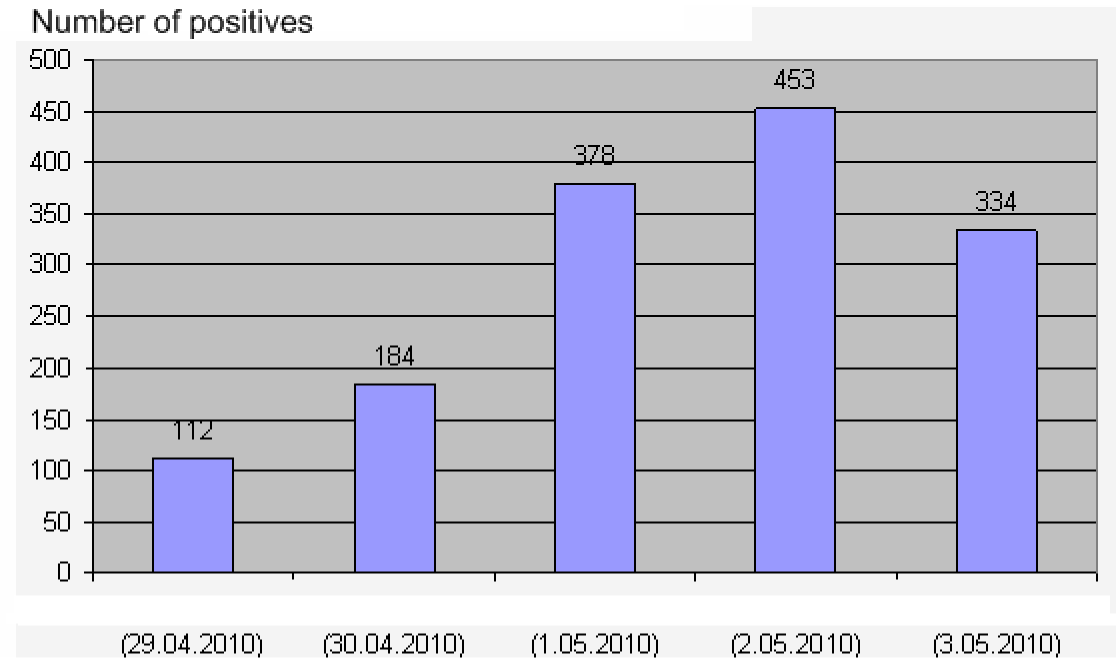

Figure1:Positives adaptive control system to break in the traffic

Assessing the **economic efficiency** of the adaptive system "Asua Brest-1". Estimated selling price "Asua Brest-1" is around 6.5 million bel. rubles (2200 USD). According to the results of tests of the system, the capacity of telephone exchanges at the intersection has increased 1.6 times. The number of vehicles in queues before the traffic light at a traffic light cycle (taken to be one minute) decreased by an average of 7.2 cars (estimated value) compared with the highly regulated switching phases of traffic lights. Using the traffic light for 12 hours a day (720 minutes) is 720 traffic light cycles. Thus the losses in car-hours per day with a hard switch regulating phases of traffic lights on below, the calculation is:

7.2 vehicle. * 720 min. = 5184 vpm. : 60 min. = 86.4 veh. / hour

In the monograph [6] value of the loss of one car / hour is 2.62 conventional units.

Economic Effect of "Asua Brest-1" is approximately:

– Per day - 2.62 c.u.hour * 86.4veh./hour. = 226.36 c.u.

– Year - 226.36 c.u. * 300 days = 67 908 c.u.

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