have been discussed. The computer application which allows the realistic simulation generated in virtual space and active participation of decision makers in innovation process has been proposed. The virtual reality technology, 3D CAD systems and optimization procedures have been integrated in this application. The very good final results of innovation modernization of PEV are also very good verification of proposed in this paper non classical approach to computer support of technical innovation processes in design process..

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COMPARISON OF THE MAXIMUM ACCELERATION OF A PASSENGER CAR ON SELECTED PAVEMENTS IN WINTERTIME

In winter, kinematic characteristics of motion are determined by varying external conditions and environmental conditions that affect the coefficient of friction. External factors affect the contact area with the road wheels in two ways: by changing the properties of the surface and affecting the mechanical properties of the tire itself. Change of tire-surface interaction parameters causes a decrease in obtained acceleration and consequently extending the braking distance of the vehicle. This paper presents the results of experimental studies of intense winter braking on two surfaces with different state.

Key words: tire, road, breaking process, coefficient of friction, winter.

Взимку кінематичні характеристики руху визначаються мінливими зовнішніми умовами та умовами навколишнього середовища, які впливають на коефіцієнт тертя. Зовнішні фактори впливають на площу контакту колеса з дорогою двома способами: через зміну властивостей поверхні та через вплив на механічні властивості самої шини. Зміна параметрів взаємодії шини з поверхнею призводить до зниження отриманого прискорення і, отже, збільшення гальмівного шляху транспортного засобу. Подано результати експериментальних досліджень інтенсивного гальмування взимку на двох різних поверхнях у різних станах.

Ключові слова: шини, дорога, гальмування, коефіцієнт тертя, зима.

Introduction

Change of environmental conditions and surface conditions during the winter introduces a contamination contact with the ground more in the form of water, snow, ice or slush [5, 9]. The temperature drop below 0 ° C may cause a number of atmospheric phenomena such as black ice, rime, snow and freezing rain snow or hail [8, 11]. These phenomena adversely affect vehicle handling significantly changing the coefficient of friction [3, 4].

A potentially hazardous for the driver weather phenomena is influenced by many factors, such as temperature and humidity, wind strength and direction, the amount and concentration of chemicals used to lower the freezing point [1, 10].

The value of the coefficient of adhesion for various types of tire – surface cooperation varies widely. An example of the range of changes in the coefficient of adhesion encountered various driving conditions are shown in Table 1.

In real conditions that can be encountered on public roads, pavement condition and thus adhesion factor may vary depending on geographic location, local building conditions, and locally occurring infrastructure [1, 8, 10].

Table 1

Range of coefficient of adhesion values for different road conditions [12]

Type and surface condition		Adhesion coefficient range	
		Contact	Slip
Concrete	Dry	0,8-1,05	0,7-0,8
	Wet	0,6-0,8	0,5-0,6
Asphalt	Dry	0,7-0,8	0,6-0,7
	Wet	0,4-0,5	0,3-0,4
Broken stone	Dry	0,5-0,6	0,4-0,5
	Wet	0,3-0,4	0,2-0,3
granite	Dry	0,6-0,7	0,5-0,6
	Wet	0,3-0,5	0,3-0,5
dirt road	Dry	0,5-0,6	0,2-0,3
	Wet	0,3-0,4	0,2-0,3
snowy road		0,2-0,4	0,2-0,3
icy road		0,15	0,15

No specific information on the impact of external environmental factors cause it is necessary to conduct research in a variety of experimental conditions and ambient conditions, and assess the impact of these conditions on the obtained longitudinal acceleration of the vehicle. This paper presents the results of experimental measurements of kinematic characteristics of a passenger car traffic on the two road surfaces.

Methodology and course of study

Aim of this study was to measure the longitudinal accelerations car Dacia Logan 1.4, year 2005. Research vehicle was equipped with winter tires in size 165/80 R14 and did not have the ABS.

Fig. 1. View vehicle research measuring apparatus during testing in February 2012

The vehicle was armed with test equipment Analog Devices type ADIS 16385 consisting of the three acceleration sensors and three gyroscopes integrated into a single measurement system. For data acquisition and archiving served a portable computer with dedicated software sensors.

Road tests were carried out in two stages, in December 2011 and February 2012. Measurements were made for the trial of intensive acceleration from a standing start (without shifting). Each attempt ended measurement intense braking to re-stop.

Test conditions

During the tests the tires are inflated to the manufacturer's specified pressure of 0.2 MPa. Environmental conditions for both stages of the test were different: in December 2011. road surface was dry (Fig. 2), and the ambient temperature was +80C. In February 2012. road surface was covered with snow mud (Fig. 3), and the ambient temperature at ground level was +20C. During the tests, the driver tried that moving the vehicle took place without loss of traction drive.

Fig. 2. Pavement view during tests in December 2011

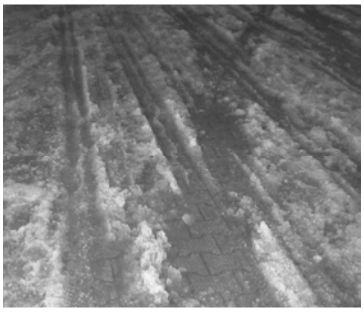

Fig. 3. Pavement view during tests in February 2012

Test results

Tested been four winter tires in size 165/80 R14. During measurements tires were mounted on steel rims size 5.5 J 14 In the first stage of testing in December 2011. six trials, were registered and in the second phase in February 2012. further 5 samples were registered.. Longitudinal acceleration waveforms obtained after the separation of the component of gravitational acceleration, angular displacements associated with the body of the vehicle, according to the developed method [6, 7] were analyzed. The whole course of acceleration obtained was divided into three phases:

Phase A – phase of start,

Phase B – vehicle acceleration,

Phase C – braking the car with the brakes.

Phase of start is characterized by an intense acceleration growth, low final speed and low displacement. In phase B, occurs essential increase of the vehicle speed to a value founded by a driver. Phase C included the braking process. Boundaries of car traffic phases were determined by making a linear approximation to accelerate progress, as shown in Figure 4.

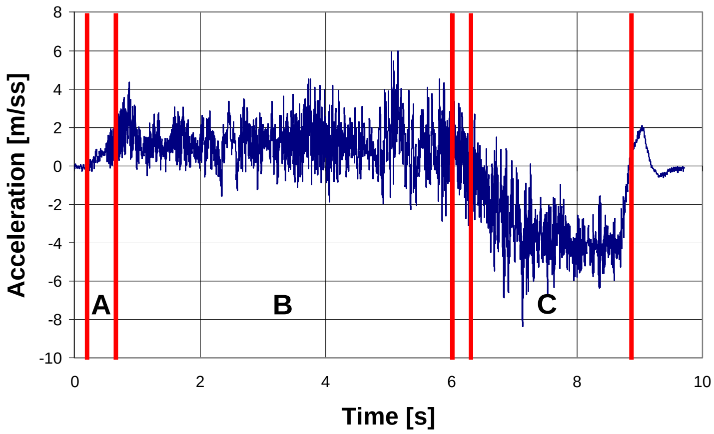

Fig.4. Acceleration characteristics of a passenger car with the designated of movement phases

Results obtained during the two stages of research are shown in Table 2 and 3.

In columns of Table 2 and 3 for the different phases of movement obtained average acceleration and duration of the motion phase are shown Verification of results was performed by making an independent measurement of the distance traveled by a measuring tape.

Table 2

Results of longitudinal acceleration average value of the vehicle for research in December 2011

PHASE A		PHASE B		PHASE C	
Acceleration [m/s^2]	Time [s]	Acceleration [m/s^2]	Time [s]	Acceleration [m/s^2]	Time [s]
+ 1,711	0,545	+ 2,738	4,535	-3,857	3,068
+ 1,436	0,932	+ 2,401	7,526	– 3,468	5,119
+ 1,809	0,871	+ 2,678	5,730	-3,862	3,989
+ 2,173	0,651	+ 2,494	5,872	-3,819	3,919
+ 1,440	1,491	+ 2,676	6,033	-4,049	4,733
+ 1,781	0,633	+ 2,720	4,147	-3,937	3,136

Table 3

Results of longitudinal acceleration average value of the vehicle for research in february 2012

FAZA A		FAZA B		FAZA C	
Acceleration, m/s^2	Time, s	Acceleration, m/s^2	Time, s	Acceleration, m/s^2	Time, s
+ 0,798	0,502	+ 0,908	2,995	– 1,828	2,6
+ 0,964	0,299	+ 1,253	4,095	– 2,106	2,584
+ 0,975	0,404	+ 1,214	4,392	-1,940	3,098
+ 0,949	0,549	+ 1,181	5,395	-3,366	2,401
+ 1,466	0,540	+ 0,983	5,656	-2,219	2,202

Analysis of test results

The results obtained were subjected to statistical analysis. As part of this analysis, standard deviation was calculated for single measurement, as well as for series of measurements. Results of statistical analyzes are shown in Table 4, and examples of waveforms of acceleration processes are show in Figures 5 and 6.

Table 4

Results of statistical analyzes for the study in December 2011 and February 2012

December 2011			
Avarage value	+ 1,725 [m/s^2]	+ 2,618 [m/s^2]	-3,832 [m/s^2]
Series of measurements standard deviation	0,250 [m/s^2]	0,125 [m/s^2]	0,179 [m/s^2]
Single measurement standard deviation	0,274 [m/s^2]	0,137 [m/s^2]	0,196 [m/s^2]
February 2012			
Avarage value	+ 1,030 [m/s^2]	+ 1,108 [m/s^2]	-2,292 [m/s^2]
Series of measurements standard deviation	0,277 [m/s^2]	0,137 [m/s^2]	0,554 [m/s^2]
Single measurement standard deviation	0,254 [m/s^2]	0,153 [m/s^2]	0,619 [m/s^2]

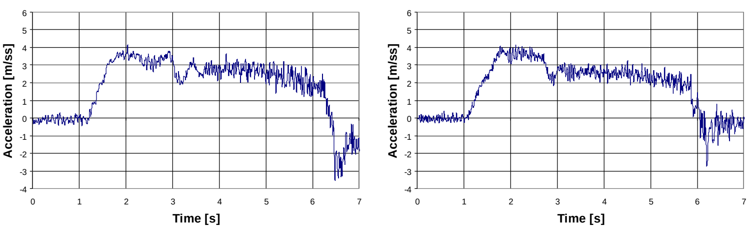

Fig. 5. Acceleration characteristics of a passenger car – December 2011

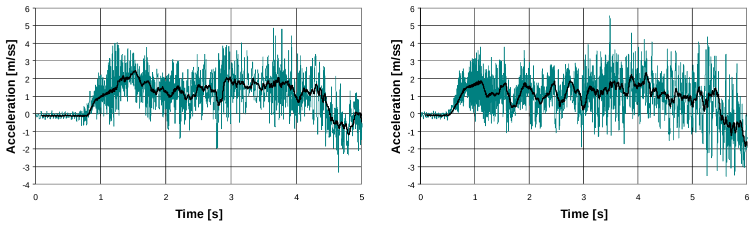

Fig. 6. Acceleration characteristics of a passenger car – February 2012

Both of the shown in Table 4 and Figure 5 shows that the acceleration of the car in conditions of dry road was smoother than in a mud-covered roadway. The calculated standard deviation for the two test stages are similar for the acceleration process. However differ significantly for the braking process. This may be caused by impurities in the form of slush as well as a greater tendency to slip on the surface. Acceleration waveforms obtained during the research in February 2012 also feature larger oscillation characteristics, which is associated with varying adhesion occurring at the measuring section.

Summary

From carried out in two stages, studies have shown that changes in surface conditions significantly affect the derived value of the longitudinal acceleration of a passenger car. Process of acceleration can be divided into two main phases associated with the start of vehicle motion and a fixed value of the acceleration that is directly related to the local coefficient of adhesion. Analysis of results for both phases of acceleration tests showed that the distribution of uncertainty around the expected value is comparable. However, the braking process for testing in February 2012. characterized by large fluctuations in the value of the delay, which affects the value of the standard deviation.

Tests have revealed relationship measurement of environmental conditions wider to those achieved acceleration of the vehicle. Studies carried out constitute introduction to experimental research of vehicle kinematic features in winter conditions.

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