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Evaluation of effectiveness of braking fragments passing performed by rally crews

Abstract. Purpose: to develop a methodology and criteria for evaluating the effectiveness of braking fragments performed by rally crews. **Material and Methods:** using the method of video shooting at 60 shot/sec, we recorded the kinematic characteristics of passing a braking fragment with length of 90 m performed by 38 rally crews of different skill level, all of them are participants of the 4th cycle of the Rally Cup of Ukraine 2014. **Results:** we have found defining, as for fragment passing time, characteristics for different groups of crews according to a position at the definite cycle, a position at the Cup testing, sporting improvement stages and vehicle classes. **Conclusions:** speed deviations at entering the braking fragment, maximum, and exit out of the braking fragment and their total deviations from benchmark indices shown by winners of the competition are realizable efficiency criteria of braking fragments performed by rally crews.

Keywords: rally, crews, fragments of braking, realizable efficiency, evaluation, criteria.

Introduction. The expert assessment of influence of factors of different nature on total results of crews in multi-stage competitions on motor rally which is carried out by authors [1], indicates the highest rating among other factors of influence on the progress of the competitive activity in the noted sport actually of preparedness of a crew (9,80 points by a ten-mark scale). The specifics of the competitive activity in motoring which are described in details in works [2; 3], demands from sportsmen especially high level of skill of driving in different conditions at the safest speed. Thus the leading role in the system "sportsman – car – road" plays actually a human factor.

Authors [2; 4] suggest comparing hour results of passing of special sites (SS) of different character by them by configuration, covering and width of a road, height differences, visibility and so forth for the objective estimation of sports-technical skill of rally crews. But, it is recommended to use batteries of special tests in works [5; 6] for estimation of sports-technical skill in motoring: on a motionless car (high-speed management and gear shifting), on exercise machines and on the ground. Relevant requirements are developed, possible mistakes, their reasons and ways of correction are noted for the estimation of quality of implementation of each test. A number of experts [7–9] consider a basis of technique of motoring skill of passing of turns. They give classification of turns by geometrical characteristics and difficulties of their passing, describe rational technique of overcoming of different turns on cars with forward, back and all driving wheels, analyze theoretical aspects of controllability of cars during the movement on curvilinear sites and so forth. The work is devoted to questions of the theory of movement of sports car by the route [10].

However the estimation of the realized efficiency of application by pilots of their skills during passing of separate fragments of the real route and the classification of its separate typical fragments developed insufficiently, as causes the relevance of the chosen direction of the research.

Communication of the research with scientific programs, plans, subjects. The work is performed according to a subject 2.17 "Modeling of biomechanical systems in difficult coordination sports" (the number of the state registration is 0111U006473) of the Built plan of the research work in the sphere of physical culture and sport for 2011-2015.

The objective of the research: to develop a technique and criteria of estimation of the realized efficiency of passing by rally crews of fragments of braking of high-speed routes. It is necessary to solve a number of tasks for the achievement of a goal, namely: to analyze the competitive activity of rally crews on special high-speed sites according to literature and pedagogical supervision, to learn passing kinematics crews of different qualification of a fragment of braking, and also to develop and to approve a technique and criteria of estimation of the realized efficiency of technique and tactics of passing of such fragments of the route.

Material and methods of the research. Before the stating pedagogical experiment it was attracted 38 rally crews – participants of the fourth stage of the national racing series "Cup of Estuaries 2014" (further – Cup) – rally "For the peace" (Nikolayev, 8-9 November in 2014) among which 13 crews at the stage of the maximum realization of individual opportunities (further – MRI), 14 – at the stage of preparation for the highest achievements (further – PHA) and 11 – at the stage of specialized basic preparation (further – SBP). The age of sportsmen – from 16 to 59 years old, among them 68 men and 8 women (one – is a pilot, seven – are navigators). The stage of the Cup of Estuaries was elected the ground of the research because it was the only full multi-stage cup of Ukraine from automobile rallies, and also the only multi-stage competition in 2014 in which at the same time crews take part at stages MRI, PHA and SBP that gave the chance objectively to compare results of their competitive activity was rather filled by participants. By means of video filming with a frequency of 60 shot/s from distance of 70 m it was registered kinematic characteristics of passing by noted crews of a certain fragment of the route of a special site (farther – SS) "Zaychevske – 2" with a total length of 90 m from a springboard after a 300-meter straight line to an entrance to a turn on 180°. The noted fragment of the route was marked by markers so that to register position of each car in every 10 m of the chosen fragment till 1/120 s (pic. 1). The application of video filming gave the chance to refuse less exact individual registrars of GPS-coordinates on each car – a peculiar revolting factor of the competitive activity. Further the average speed and average acceleration on each piece, a place of the maximum speed and the maximum acceleration, a way of braking and so forth paid off. Results of the pedagogical analysis of the competitive activity of rally crews undertook, hour sports results and the place in the rally "For the peace" is taken in attention by each crew and following the results of a four-landmark Cup, and also the stage of their long-term sports improvement during the analysis and interpretation of the received results. The mathematical processing of the received results provided

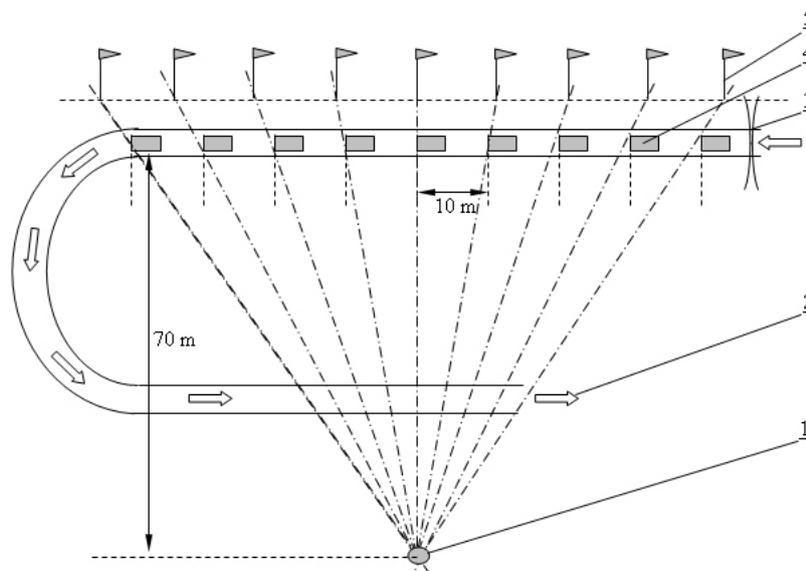
their check on distribution normality, calculation of the main statistical characteristics for the untied selections, and also correlation coefficients for Bravais-Pearson as all sizes that were compared, were parametrical.

Results of the research and their discussion. The pedagogical supervision of the competitive activity in motoring gives the chance to claim that the whole route can conditionally be distributed on standard fragments of three types: a) – dispersal, b) – braking, c) – turn passing. Any races begin with dispersal – a fragment of type a). After it braking comes surely – a type fragment b) before an entrance to a turn – a type fragment c).

Passing by a crew of each fragment is characterized by three main kinematic characteristics: speed of an entrance to a fragment, times passing of a fragment and exit speed from it which is the speed of an entrance to the following fragment of the route.

The simplest for estimation of the efficiency of its passing are fragments of type a). The difference of speeds on an entrance and at an exit from such fragment has to be the greatest, and criterion of the efficiency is absolute time of its passing.

It is much more difficult to estimate efficiency of passing of a fragment of type b) before a type fragment c). Thus any of the noted kinematic characteristics can't be applied as the only criterion of efficiency of passing of such fragment of the route. For the justification of the objective criterion we will consider a model of passing rally crew of a standard fragment of the route of SS of type b) after a fragment of type a) before a type fragment c) (pic. 1).



Pic. 1. Scheme of registration of kinematic parameters of passing by rally crews of a fragment of the route of a special site:

1 – video camera arrangement; 2 – direction of the movement of the car; 3 – “springboard”; 4 – car outlines; 5 – markers

For the detection of the most significant kinematic characteristics of passing of the chosen fragment of a distance we investigated correlation interrelation of fifteen different characteristics with total sports results of crews – the participants of competition expressed as average speed on all SS (in km/year.) without road and other penalties.

The main kinematic indicator of passing by crews of the chosen fragment – time of its passing – the most often correlates with the maximum speed registered on a fragment ($r = -0,93000$) with a speed of an entrance to the following fragment in ($r = -0,85546$) but with a speed on a springboard which would be the speed of an entrance to a fragment ($r = -0,83926$). The maximum speed closely correlates with a speed on a springboard ($r = 0,939066$) and with average narrowness – with a speed of an entrance to the following fragment of the route ($r = 0,694183$). Therefore it is expedient to consider the noted characteristics when developing the criterion of efficiency of passing by crew of a concrete fragment of the route of SS.

The average by narrowness correlation communication of time of passing of the chosen fragment is found out with an average speed of crew on all SS

($r = -0,695350$) that parametrically displays total sports result at the stage. The significant correlation communication is found between times of passing of a fragment and the maximum acceleration of braking ($r = -0,580382$), and also the average speed ($r = -0,51027$) specified to a car class.

Undoubtedly, the main indicator for the estimation of the realized efficiency of passing by crew of a certain fragment of a distance is time of its passing. Insufficient speed of an entrance to the following fragment worsens result of its passing therefore it is expediently obligatory to consider also this indicator. Speed theoretically has to be maximum on an entrance to a type fragment b). Its size will be defined by a length and a character of a covering of the previous fragment, technical characteristics of a car and technical skill of a pilot.

The safest speed of an exit from a type fragment b) will be defined by characteristics of the following curvilinear fragment of type c). Skill of crew is defined by ability most close to approach this speed as the insufficient speed of an exit will significantly worsen at once time of passing of a fragment c) because of need of additional dispersal of a car, and its

excess at best will force a pilot to choose less fast trajectory of passing of a curvilinear fragment (that will also increase the time of its passing) or will bring to an abandonment of the route and damage of a car (loss of tens of seconds or minutes or even an abandonment from a distance). Intensity of braking significantly changes a ratio of length of adjacent fragments of type a) and b) in interests of the first. The point of the top of extreme – the greatest speed – divides these fragments among themselves.

The quicker the crew is included into the shown fragment of the route in pic. 1, the better time of its passing to what testifies a close correlation connection between passing times crew of a fragment and its speed on a springboard which is the speed of an entrance to this fragment. As in rally result will be defined not in absolute values, and behind the taken place, as a standard of the maximum speed of an entrance to a fragment b) it is possible to accept the best indicator among all participating crews; this most concerns also the speed of an entrance to the following fragment c). For specific road conditions and character of a fragment of type b) there is some maximum safe speed for which it is conditionally possible to take average among three-four best results. At the determination of such speed it is also possible to consider a test group or a class of a car if there is statistically essential intergroup difference between such indicators.

However the analysis of results of participants of the stated pedagogical experiment (tab. 1) which is organized during the rally "For the peace" (Nikolayev, 08-09 November in 2014) shows that such approach to estimation of the efficiency of passing by crews of the chosen fragment of the route isn't objective up to the end, displays only statistically processed average values and doesn't consider a number of additional factors.

Table 1

Kinematic characteristics of passing of a fragment of SS "Zaychevske – 1" from a springboard to the left turn of twenty best participants of the rally "For the peace" (Nikolayev, 8-9 November in 2014)

№	Class a/m	V _{aver.} ³ km/year.	V _{spr.} ³ km/year	V _{max} km/year	a _{max} ² m·s ⁻²	Time, s	V _{ent.} ³ km/year	Place in abs.		Place in cl.	
								stage	Cup	stage	Cup
1	P8**	106,12	116,76	123,44	-8,78	2,85	74,48	1	1	1	1
4	P8**	105,47	116,76	119,99	-8,91	2,78	81,51	2	4	2	3
3	P8**	105,31	116,76	116,75	-8,36	2,86	77,14	3	2	3	2
2	P8**	104,03	113,68	119,99	-8,91	2,78	80,00	4	11	4	1
12	P8*	103,73	110,77	116,75	-9,02	2,95	71,48	5	12	5	11
5	P8	102,04	113,68	119,99	-10,53	2,81	77,14	6	3	6	4
8	P8**	104,41	116,76	123,44	-10,92	2,67	86,10	7	6	7	6
17	P8*	99,97	108,00	113,69	-12,37	2,95	72,00	8	17	8	16
9	P8*	99,40	127,06	127,04	-10,49	2,78	80,00	9	19	9	15
29	Ps6**	98,46	135,00	135,00	-12,38	2,67	83,08	11	13	1	1
67	P8**	96,91	116,76	119,99	-8,88	2,89	77,14	12	21	11	18
26	P6**	97,04	120,00	119,99	-13,22	2,80	83,08	13	22	1	1
11	P8*	96,23	98,18	116,75	-10,08	2,86	80,00	14	23	2	19
25	P7**	95,89	100,47	105,37	-7,26	3,15	73,22	15	15	1	2
34	P6	95,53	105,37	108,00	-7,67	3,09	67,50	16	24	2	2
20	P8*	95,15	110,77	113,69	-7,84	2,88	78,55	17	25	13	20
27	Ps6	94,99	108,00	108,00	-11,18	3,18	65,45	18	28	2	2
16	P8	93,87	110,77	110,77	-7,36	3,18	65,45	19	27	14	13
41	P6	92,01	110,77	113,69	-8,74	3,07	66,46	20	28	3	6
31	Ps6	91,85	116,76	116,75	-11,73	2,92	80,00	21	29	3	9

Note. ** – is the stage of the maximum realization of individual opportunities; * – is the stage of preparation for the highest achievements; without * – is the stage of specialized basic preparation. On three best indicators are highlighted in bold type.

Not all crews which quickly enter the route fragment elected by us, also quickly leave it: the correlation coefficient between speeds of an entrance and an exit makes only $r=0,605538$. The vast majority of crews (72%) after an entrance to the noted fragment continue dispersal, and exceptions are crews which entered a fragment with the maximum speed in comparison with their competitors. The correlation coefficient between times of passing of the fragment which was chosen for the research and the maximum speed appeared was the closest ($r=-0,93000$), that is it is expedient to continue dispersal after an entrance to this fragment. Considering the existence on an entrance of the chosen fragment of a springboard and risk to damage a car after a far jump, and also impossibility to disperse and direct a car in flight, eight crews which as a result were ahead of all others, chose tactics of a smaller speed of an entrance to a springboard and a shorter jump with further dispersal.

The crews of st. No. 9, 29 and 26 which are entered a springboard at the greatest speed (127,06, 135,00 and 120,00

km/year. respectively, in comparison with a similar indicator of prize-winners of the rally – 116,76 km/year.), as a result took the subsequent places (9, 10 and 12) that it is possible to explain by a superfluous riskiness, made mistakes and essential overloads of their cars. The indicative places are the taken by them places and following the results of the Cup – the thirteenth, nineteenth and twenty second.

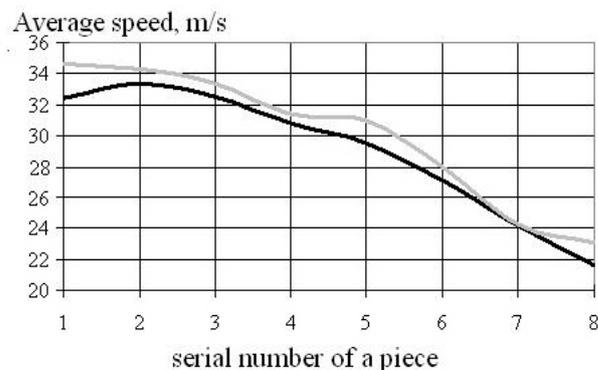
However the crews of No. 29 and 26 acted on weaker cars of the classes Ps6 and P6 with forward lead wheels, and such cars in comparison with four-wheel drive strong analogs of the class P8 don't give to pilots the tactical chance effectively to disperse after braking. The noted crews, despite of risk and overload on the cars, won first place both at the fourth stage in their classes, and following the results of the Cup which indicates certain differences of the creation of tactics of the competitive activity of rally crews which act on the most powerful four-wheel drive cars, and sportsmen who use less powerful mono-wheel drive technique.

The data provided in tab. 2 and in pic. 2 give the chance to compare nature of change of speed of the movement on the chosen fragment of the route of crews which showed its maximum sizes with similar indicators of leaders following the results of the rally.

Table 2

Average speed on separate pieces of a fragment of the route of SS of crews by which reference indicators were paid off

Number of pieces	1	2	3	4	5	6	7	8
Dist. from spr., m	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89
St. № crew	Average speed on a piece, m·s ⁻¹							
8	32,43	34,29	33,33	31,58	31,58	30,00	26,09	24,00
9	35,29	34,29	33,33	31,58	30,00	27,27	23,08	22,22
29	37,50	35,29	35,29	31,58	31,58	28,58	24,00	23,08
26	33,33	33,33	31,58	30,77	30,77	26,09	24,00	23,08
X ₁	34,64	34,30	33,38	31,38	30,98	27,99	24,29	23,10
1	32,43	34,29	33,33	30,77	29,27	26,09	24,00	20,69
4	32,43	33,33	33,33	31,58	29,27	27,91	24,49	22,64
3	32,43	32,43	30,77	30,00	30,00	27,27	24,00	21,43
X ₂	32,43	33,35	32,48	30,78	29,51	27,09	24,16	21,59



Pic. 2. Average speed on pieces of the chosen fragment of the route of SS of crews with the highest indicators (I) and leaders of the competition (II)

The crews of st. No. 8, 9, 29 and 26 which showed the highest indicators of speed, are included into a fragment at the maximum speed (34,64 m·s⁻¹) which after a springboard decreases gradually. On a site of 40-50 meters its stabilization is observed about 31,30 m·s⁻¹ at the level, then the intensive braking (to 24,29 m·s⁻¹) begins, and on the last ten meters its intensity sharply decreases, and at a speed of 23,10 km/year they enter turn – in the following fragment of the route c). Theoretically these crews could keep the speed shown on a springboard more long, however a “distant” jump throughout 20–25 meters, inevitable after the high speed of an entrance, doesn't give them the chance to disperse, causes a considerable destabilization of the car during its landing and demands additional actions for its course alignment (by the way, the part of crews which exceeded the safest for them speed on this springboard, for several years experience on this fragment respectable accidents and revolutions). Only upon the termination of the first emergency braking and alignment of the car, on the small piece about 10 m long noted above they manage to stabilize speed, and the following – also close to emergency – braking begins further. Precisely to calculate its efficiency is very difficult therefore on the last ten meters of a fragment noted crews cease to brake to enter turn at a speed which is calculated by them.

But the crews of the group of leaders of the rally (st. No. 1, 4 and 3) are included into a springboard on 0,90 m·s⁻¹ more slowly ($V_{spr.} = 32,43 \text{ m·s}^{-1}$); further throughout 15–20 meters they continue to disperse to the maximum speed (to $V_{max} = 33,35 \text{ m·s}^{-1}$) then start braking with almost stable acceleration up to the entrance to turn – to $V_{ent.} = 21,59 \text{ m·s}^{-1}$ (on 0,51 m·s⁻¹ more slowly, than the previously considered crews).

Such way of passing of the noted route fragment, despite of the slightly worst time (approximately on 0,10 s) gives the chance to avoid the destabilization of the car after a jump, controlling it throughout the whole fragment, on a certain piece to continue its dispersal, and also to lower an overload from landing and the emergency braking more precisely to calculate the safe speed of an entrance to the following fragment of the route on it. Total results of the rally completely would confirm advantages of such way of passing of similar fragments of the route of SS of type b).

The integrated criterion of the realizes efficiency of technique of passing by crews of a fragment of the route of SS of type b) has to consider all three kinematic characteristics which most closely correlate its passing over time, – $V_{spr.}$ are noted above., V_{tmax} and $V_{ent.}$. It seems expedient as such criterion to calculate the sum of deviations of the noted speeds of a concrete crew from certain reference indicators which can be or the speed of crews which showed their highest sizes, or speeds of leaders of the competition. The comparison of speeds of $V_{spr.}$ is given in tab. 3-5., V_{tmax} and $V_{ent.}$, and also their deviations from the reference sizes elected by us for different groups of crews. They are prize-winners, who finished on the subsequent places, and who ascended at the fourth stage of the Cup; prize-winners, crews who took places from the 4th till the 8th, and crews who took places below the eighth following the results of the four-staged Cup; crews at the stage of the maximum realization of individual opportunities (MRI), at the stage of preparation for the highest achievements (PHA) and at the stage of specialized basic preparation (SBP).

It was found out by us that at any ways of calculation of a total rejection of kinematic characteristics of passing by participants of the pedagogical experiment of the chosen fragment of the route of SS from reference, for leaders of the fourth stage of the Cup they are higher from similar indicators of crews which finished on the subsequent places, and their indicators, in turn, are higher than indicators of crews which didn't finish a distance. Such indicators of crews have also essential advantage at the stage of MRI over indicators of crews at the stage PHA, and indicators of the last – over indicators of crews at the stage SBP. The noted characteristics of leaders of the four-staged Cup are also higher from the same indicators of the crews which took the subsequent places, however the crews who took final places from the 4th till the 8-th have no advantage over the crews who took places below the eighth as highly skilled crews were among the last which, except the fourth stage of the Cup, at other its stages mainly didn't start that didn't give them the chance to gain the sum of points, big from their competitors, following the results of four stages, despite of rather high realized efficiency of passing of the chosen fragment of the route of SS by them. However the greatest and statistically reliable differences between speeds on a springboard, maximum and to an entrance to the following fragment of the route, and also between their deviations from reference and between total deviations Δ it is noticed rather reference characteristics of leaders of the stage taking into account a sign at their calculation.

The comparison of coefficients of correlation between passing times crews of the chosen fragment of the route and the most powerful kinematic characteristics of its passing (tab. 3) specifies that correlation coefficients between their deviations from reference, despite of their choice (the highest values or characteristics of leaders of competition), statistically don't differ (0,85033 and 0,85034 for $\Delta V_{spr.}$; 0,93509 and 0,93517 for ΔV_{max} and 0,95191 and 0,94331 for an amount Δ), except a deviation from exit speed from a fragment (0,82488 and 0,77508). Considering the tactical advantage of a way of passing of a fragment by leaders, for estimation of the realized efficiency of passing by concrete crews of fragments of routes of SS of type b) as reference it is possible to recommend actually characteristics of leaders of the competition, but not their maximum values. Differences between reference and actual speeds, as well as a total deviation Δ it is better to count taking into account a sign as without its account the narrowness of interrelation between the calculated differences and times of passing of a fragment are significantly lower (0,75699, 0,64534, 0,84378 and 0,86190 respectively).

Table 3

Correlation interrelation between times of passing of the chosen fragment of the route of SS and the most influential kinematic characteristics of its passing for different ways of their calculation

Way of calculation	$V_{spr.}$ km/year	$\Delta V_{spr.}$ km/year	$V_{ent.}$ km/year	$\Delta V_{ent.}$ km/year	V_{max} km/year	ΔV_{max} km/year	Amount Δ km/year
For maximum	-0,85034	0,85033	-0,82505	0,82488	-0,93509	0,93510	0,95191
For maximum *	-0,83926	0,83915	-0,85555	0,85541	-0,93002	0,93002	0,95149
For leaders	-0,85034	0,85034	-0,82505	0,77508	-0,93509	0,93517	0,94331
For leaders *	-0,83926	0,83926	-0,85555	0,81696	-0,93002	0,92997	0,94393
For leaders abs. dev.	-0,85034	0,75699	-0,82505	0,64534	-0,93509	0,84378	0,86190
For leaders abs. dev.*	-0,83926	0,76669	-0,85555	0,73304	-0,93002	0,86048	0,88390

Note. * – taking into account crews which ascended at the stage.

Correlation coefficients between times and the offered criteria of the realized efficiency of passing of the chosen fragment of the route for crews which act on cars of different groups and classes are provided in tab. 4. It was appeared that for crews which act on the most powerful class P8 cars with a drive gear on all wheels, the vast majority of the noted correlation coefficients (and especially for a deviation from reference speed on a springboard – 0,44464) is statistically reliable below similar indicators of crews which act on cars with a drive gear on one axis, and from average values. The exception makes only a deviation from the speed of an entrance to the following fragment of the route. The found differences should be considered during estimation of the realized efficiency of technique of passing of such fragments of routes of SS and an individualization of preparation of separate crews.

Considering a rather small number of crews in classes (5 in the class Ps6, 5 in the class P7, 9 in the class P6 and seven in the class P5 in comparison with 14 crews in the class P8), the received results can be applied only to these concrete selections.

Table 4

Correlation interrelation between times of passing of the chosen fragment of the route of SS and the most influential kinematic characteristics of its passing for different classes of cars

Class of cars	$V_{spr.}$ km/year	$\Delta V_{spr.}$ km/year	$V_{ent.}$ km/year	$\Delta V_{ent.}$ km/year	$V_{max.}$ km/year	$\Delta V_{max.}$ km/year	Amount Δ km/year
P8 (four-wheel drive)	-0,44464	0,44464	-0,93606	0,85682	-0,82369	0,82369	0,82892
Mono-wheel drive	-0,88079	0,88079	-0,80373	0,75724	-0,92287	0,92280	0,94485
Class PS6	-0,96009	0,96009	-0,96055	0,96055	-0,96358	0,96327	0,97256
Class P7	-0,98609	0,98609	-0,64272	0,64272	-0,95594	0,95594	0,98069
Class P6	-0,77750	0,77750	-0,91526	0,75786	-0,89587	0,89587	0,90027
Class P5	-0,87513	0,87513	-0,62997	0,62997	-0,94779	0,94826	0,96281
All cars	-0,85034	0,85034	-0,82505	0,77508	-0,93509	0,93517	0,94331

Conclusions:

1. They can conditionally be divided into three groups of fragments for estimation of the realized efficiency of technique of passing by rally crews of routes of SS: dispersal (type a), braking (type b) and passing of turns (type c). Tactics of passing of fragments of braking of type b) with a springboard on an entrance is the least studied.

2. Tactics of passing of such fragments of braking by their leaders (moderate speed on a springboard, continuation of dispersal after a phase of flight and a stable braking up to an entrance to turn) is recommended from positions of high total sports result of multi-stage competitions from motor rally but not tactics of crews which showed the minimum time of passing of such fragment with the maximum speed on a springboard, the first emergency braking with additional stabilization of the car after a jump and the second early emergency braking before an entrance to turn.

3. The objective criteria of estimation of the realized efficiency of passing of fragments of braking the rally of SS with a springboard on an entrance is a deviation of speeds of an exit from a springboard maximum on a fragment and to an entrance to the following fragment of the route of a concrete crew from reference average values of leaders of multi-stage competition, and also a total deviation of the noted speeds. Values of these criteria are statistically authentically lower for crews – prize-winners in their classes following the results of the stage and multi-stage competition, than for the crews which took the subsequent places or ascended, and also for the crews at the stage of MRI in comparison with their competitors at the stages of PHA and SBP.

Prospects of the subsequent researches. The development of a technique of individual sports-technical training of rally crews on the basis of an objective estimation of the realized efficiency of passing by them typical fragments of routes of SS with an application of modern GPS-technologies of an express measurement of kinematic parameters of a movement.

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