

New calculation of accelerations in imoClient-version 6.3.12.x



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1. Introduction

In this document we will explain the update on the way of calculating accelerations and decelerations in imoClient-version 6.3.12.x (compared to version 6.3.9.x and earlier; see Chapter 2), which has been done because in the former version the calculation could be unclear and was less flexible compared to the new calculation. We will also explain the differences in outcome between versions (Chapter 3), which will be minimal when no settings are actively changed by the user. Chapter 4 will address the changes regarding acceleration categories. Finally Chapter 5 explains a relevant recent update of the layout of the 'Exertion Analyze Options'.

When there is a difference between accelerations and decelerations this will be explained; otherwise, with the term 'accelerations' you can read 'decelerations' as well.

Changes in settings and calculation of (total) accelerations 2.1 Former settings in 'Exertion Analyze Options'

In the former imoClient-version four fields could be defined for the 'Acceleration options' in the 'Exertion Analyze Options' (ANALYZE_DEF in database). In Table 1 these settings are explained for the former situation.

	Setting	Database name	Explanation
1	Min. speed for	ANL_ACCEL_MIN_SPEED	General: Minimal speed that has to be reached to be
	accel.		counted as an acceleration.
			Acc: (sometimes) the moment the acceleration starts
			Dec: (sometimes) the moment the deceleration stops
2	Minimal	ANL_ACCEL_MIN_ACCEL	General: Minimal acceleration that has to be reached
	acceleration		to be counted as an acceleration.
			Acc: (Sometimes) the moment the acceleration
			starts. The acceleration stops when it is below the
/			'minimal acceleration'.
/			Dec: (Sometimes) the moment the deceleration
			stops. The deceleration starts when it is above the
			'minimal acceleration'.
3	min. accel. Time	ANL_ACCEL_MIN_TIME_MS	Minimal time the acceleration has to be above the
			'Minimal acceleration' & 'Min. speed for accel.'.
4*	Max valid	ANL_ACCEL_MAX_VALID_ACC	When this acceleration value is reached the
	acceleration		acceleration is not counted.

Table 1. Former 'Exertion Analyze Options'

*see chapter 5.1 about the new layout of the Exertion Analyze Options Color coding: orange = changed in new version, red = removed in new version.

The outcome of these settings is the total amount of accelerations in the Exertion module ('# Accel in the 'Summary') and in the database ('TA_ACCEL_COUNT' in the 'TP_ANALYZED' table).

2.2 New settings in 'Exertion Aalyze Options'

In the new imoClient-version there is an additional field, which will make the definition more clear. In Table 2 the new settings are explained for the new situation.



Table 2. New 'Exertion Analyze Options'

	Setting	Database name	Explanation	
2	Minimal	ANL_ACCEL_MIN_ACCEL	Minimal acceleration that has to be reached to be	
	acceleration		counted as an acceleration. The acceleration always	
			starts/stops when it is respectively above/below	
			the 'minimal acceleration'.	
ne	Min. accel. time	ANL_ACCEL_MIN_ACCEL_TIME_MS]	Minimal time the acceleration has to be above the	
w			'Minimal acceleration' during the acceleration.	
1	Min. speed in	ANL_ACCEL_MIN_SPEED	Minimal speed that has to be reached to be counted	
	accel.		as an acceleration & (sometimes) the moment the	
			acceleration starts/deceleration stops	
3	min. accel.	ANL_ACCEL_MIN_TIME_MS	Minimal time the acceleration has to be above the	
	Time	[ANL_ACCEL_MIN_SPEED_TIME_MS]	'Min. speed in accel.' during the acceleration.	
	min. accel. time			
	above speed			
4*	Max valid	ANL_ACCEL_MAX_VALID_ACC	When this acceleration value is reached the	
	acceleration		acceleration is not counted.	

*see chapter 5.1 about the new layout of the Exertion Analyze Options Color coding: orange = changed in new version, red = removed in new version, Green = new in new version

2.3 Main change in calculation

The main difference between the imoClient-versions is the definition of when an accelerations starts and a deceleration stops.

In the former version an acceleration did start the moment when both conditions of 'minimal speed for acceleration' and 'minimal acceleration' where met. Therefore, the start was sometimes the moment the threshold of 'minimal speed for acceleration' was reached and sometimes the moment the threshold of 'minimal acceleration' was reached.

However, if you have a look at the acceleration graph (Figure 1), one could argue in the start of the acceleration should be earlier and always at the moment the 'minimal acceleration' threshold (here 1.5 m/s²) is reached.



Figure 1. Start of acceleration in former (blue line; @2 m/s) and new (orange line; @1.5 m/s²) imoClient-version.



Therefore, we changed the calculation, but in such way that the number of accelerations will be approximately the same when no change in the settings is done.

For decelerations the main change is in the end of the deceleration: it was the moment one of the two conditions regarding 'minimal speed' or 'minimal acceleration' was not met anymore. Now it is always the moment the signal gets below the 'minimal acceleration' (see Figure 2).

E	🚍 modules 💀 Exertion Analyze Options 🖹 Exertion 📄 modules 💌						
• a	* acceleration/speed of Sergino Dest						
10	0 msec		29				
	0,5		28				
	-0.5		27				
	-1		25				
	-1,5		24				
	-2		- 22				
- 2	-2,5		21				
	-3		- 19				
/s2)	-3,5		18				
<u>ا</u>	-4		16 00				
ratio	-4,5		15				
ccele	-5		13				
	-5,5		12				
	-6.5		10				
	-7		-9				
	-7,5	No and you want they want the state of the	- 7				
	-8		-6				
- 2	-8,5		- 4				
	-9		- 3				
1	9,5		-1				
	-10 J		0				



2.4 Automatic migration of settings

After upgrading imoClient your settings will be migrated so there should be no difference when you do not change anything. For example, the settings in Figure 3 give (approximately) the same result in the exertion module. Note that the 'minimal acceleration time' and 'minimal acceleration time above speed' have equal values in the new situation (Figure 3B). Also note that the order has changed to make it more logical.





4 Max valid acceleration



(B) NEW CORRESPONDING SETTINGS

0)		JEIII	105
	Acceleration options		
2	Minimal acceleration	1,5 ‡	m/s ²
New	min. accel. time	0 ‡	ms
1	Min. speed in accel.	2 ‡	m/s
3	min. accel. time above speed	0 ‡	ms
4	Max valid acceleration	9 ‡	m/s ²

9 🗘 m/s²



3. Changes in outcome variables

3.1 Minimal changes in number of total accelerations

We took a random LPM recording of a 106-minute training session with 16 players and compared the total number of accelerations (and decelerations) with the settings of Figure 3. On average the relative difference is only around 0,5% for both accelerations and decelerations, with a maximum of +1,9% (5 extra on 268 accelerations; see Table 3).

Table 3. Comparison in total accelerations and decelerations (and max value) between former and new settings/calculation.

		# Accel.			# Decel.			
Vest	old	new	abs diff	rel diff (%)	old	new	abs diff	rel diff (%)
1	236	234	-2	-0,8	229	228	-1	-0,4
2	264	265	1	0,4	263	267	4	1,5
3	244	244	0	0,0	223	227	4	1,8
4	301	302	1	0,3	299	302	3	1,0
5	272	273	1	0,4	269	268	-1	-0,4
6	213	213	0	0,0	198	198	0	0,0
7	296	297	1	0,3	284	286	2	0,7
8	193	195	2	1,0	175	176	1	0,6
9	242	244	2	0,8	195	196	1	0,5
10	288	292	4	1,4	281	282	1	0,4
11	268	273	5	1,9	241	244	3	1,2
12	247	247	0	0,0	237	236	-1	-0,4
13	285	285	0	0,0	269	268	-1	-0,4
14	281	283	2	0,7	266	266	0	0,0
15	273	274	1	0,4	266	266	0	0,0
16	271	275	4	1,5	270	271	1	0,4
avg	260,9	262,3	1,4	0,5	247,8	248,8	1,0	0,4

3.2 Reasons for change in number of total accelerations

In some (rare) cases additional accelerations are counted in the new situation (Figure 4). These accelerations just reach the minimal duration and/or speed threshold in the new situation. This is due to a slight difference in the calculation of the duration in the new situation, which systematically increases the duration with 10ms. If you really want to exclude these accelerations in the new situation you could add an extra 10ms to the 'min. accel time above speed'.



Figure 4. Example of a deceleration that is counted in the new but not in the former situation.



Some accelerations are not counted anymore in the new situation. This is because in the former situation it was possible that the latter part of a false acceleration (exceeding the 'max valid acceleration' threshold) was counted as an actual true acceleration (see Figure 5). In the new situation this is not possible anymore and this false acceleration is removed.



Figure 5. Acceleration that is most likely not a real/valid acceleration, but counted with the former settings

With the former client version the acceleration took about 120 ms (blue line). It was started when the speed reached 2 m/s (red line). In this period the maximum acceleration was about 8.2 m/s², which is lower than the max valid acceleration (yellow line). Therefore it is regarded as a correct acceleration and counted as such.

With the new client version the acceleration took 280 ms (green line). It was started when the acceleration was more than 2 m/s². In this period the maximum acceleration was about 11.2 m/s², which is higher than the max valid acceleration (yellow line). Therefore it is regarded as a false/incorrect acceleration and not counted.

When we took a look at the data with the video we saw it was a false acceleration on the border of the pitch.

3.3 Minimal changes in acceleration characteristics

Because the definition of the start of an acceleration has changed (see Figure 1), for at least a part of the accelerations some acceleration characteristics will change. How much this will change will depend on your settings.



For a small dataset (training of 2 players), using the settings in Figure 6, the differences between the former and new version are presented in Table 4. Besides the systematic increase of the duration with 0,01s for all accelerations, respectively 14 and 4% of the accelerations and decelerations had different characteristics. For example, the duration was on average 0,10 (accelerations) and 0,05 (decelerations) seconds higher. Also distance and minimal speed during acceleration changes. There were no changed in the maximal speed and maximal acceleration.

Acceleration options		
Minimal acceleration	2 ‡	m/s²
min. accel. time	0 ‡	ms
Min. speed in accel.	1 ‡	m/s
min. accel. time above speed	150 ‡	ms
Max valid acceleration	8 ‡	m/s²

Figure 6. Settings for outcome in Table 4.

Fable 4. Average differences in a	acceleration characteristics	between former an	d new version.
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	% of total that changed	Duration (s)	Distance (m)	Minimal speed during acceleration (m/s)
Accelerations	14	0,10	0,08	-0,20
Decelerations	4	0,05	0,02	-0,08

In another training session 1 player was analyzed using the settings in Figure7. The differences between the former and new version are presented in Table 5. Besides the systematic increase of the duration with 0,01s for all accelerations, respectively 80 and 60% of the accelerations and decelerations had different characteristics. For example, the duration was on average 0,10 (accelerations) and 0,05 (decelerations) seconds higher. Also distance (max 0,78), minimal speed during acceleration (max -0,81) and maximal acceleration (max 2,18) changed. There were no changes in the maximal speed during the acceleration.

Acceleration options		
Minimal acceleration	1,5 ‡	m/s²
min. accel. time	0 ‡	ms
Min. speed in accel.	2 ‡	m/s
min. accel. time above speed	0 ‡	ms
Max valid acceleration	9 ‡	m/s ²

Figure 7. Settings for outcome in Table 5.

Fable 5. Average difference	es in acceleration characteristics	s between former and new version.
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	% of total that changed	Duration (s)	Distance (m)	Minimal speed during acceleration (m/s)	Max acceleration (m/s ²)
Accelerations	80	0,34	0,47	-0,89	0,11
Decelerations	60	0,32	0,46	-0,81	0,16

As you can see in Table 4 and 5 the amount of accelerations that differ between versions and the magnitude of differences depend on the settings of the 'Exertion Analyze Options'. With a higher 'minimal speed in acceleration' and a higher 'minimal acceleration time above speed' the changes will usually be higher than with low values of these settings.



3.4 Why it can be a good idea to adjust the new settings

In the previous paragraphs we explained what will (marginally) change when you will not adjust your settings. However, it could be a good idea to adjust the new settings, since the new settings will provide a clearer definition of an acceleration.

Especially when you have a definition with a relatively high minimal time above the acceleration and speed threshold, the new results could be more to what you would like and/or expect in comparison with the former results. An example of a definition with such higher thresholds, is the one used in Stevens et al. (2017, JSS): at least 0,5 seconds above 1,5 m/s2 & has to reach 10 km/h (Figure 8).

Acceleration options			
Minimal acceleration	1,5	÷	m/s²
min. accel. time	500	\$	ms
Min. speed in accel.	2,778	÷	m/s
min. accel. time above speed	0	÷	ms
Max valid acceleration	9	\$	m/s²

Figure 8. Exertion Analyze Options of the settings used in Stevens et al (2017, JSS).

In such cases, in the former situation accelerations that seemed right, were not always counted, because the condition for the minimal time above the speed threshold (which was always equal to the time above the acceleration threshold, here 500 ms) was not met (Figure 9; red line). And when it was (just) met, the acceleration characteristics (duration, distance) were much lower than in the new situation. With the settings of Figure 8 the acceleration is now counted (Figure 9; blue line).



Figure 9. Acceleration that could not be accurately counted in the former situation (duration above speed threshold too short; see red line), but is counted with in the new situation (duration long enough; see blue line).



4. Changes in acceleration categories

4.1 Former and new settings in 'Acceleration categories'

In the former situation there was only one minimal time ('Min Duration') for both the minimal speed ('Min. Speed') and the minimal acceleration ('Min Accel'). In the new situation it is possible to set it separately for minimal speed ('Min time speed') and minimal acceleration ('Min time accel'; Figure 10).

lheid F	lartslag Acceleration E	Deceleration Power	Sprint Category	Acceler	ation category	Deceleration Category Im
celera	tion Categories					
ID	Min Duration (sec)	Min. Speed (km/h)	Min Acceleration (n	n/s²)	Omschrijving	
1	0,100	7,20	1,5			
2	0,100	7,20	3			
3	0,100	7,20	4,5			
	- an roon caren					
figuratie Ieral Liv elheid H ccelerat	e data server Zones E artslag Acceler tion D cion Categorie	Export defaults Mon receleration Power	re Sprint Category	Accelera	ation category	Deceleration Category Im
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figuration ieral Liv elheid H ccelerat ID 1 2	e data server Zones E artslag Accelerition C ion Categoric Min time speed (s) 0,100 0,100	Expon defaults Mo ecceleration ower Min. Speed (km/h) 7,20 7,20	Min time accel (s) 0,1 0,1	Accelera Min Ac 1,5 3	ation category	Deceleration Category Im

Figure 10. Minimal duration in the former situation (A) is now split for both minimal acceleration and minimal speed (B).

Also here, when you as a user don't change anything and use your own 'imoClient.ini'-file, the new situation will be the same as the former situation: it will automatically fill in earlier set 'Min time' for both fields.

4.2 Change in number of accelerations within categories

If you use acceleration categories it could be that these have changed as well. Usually in the new situation there will be more accelerations in the higher categories. However, when you don't change the settings, these changes will be small as well.

Nevertheless, it could be wise to reconsider you acceleration categories, since now it is possible to set the minimal duration for acceleration and speed separately.



5. Change in layout 'Exertion Analyze Options'

In imoClient-version 6.4.14.418 and higher there is a new layout of the 'Exertion Analyze Options'.

The most important change regarding the topic of the calculation and definition of accelerations is that with the new layout there is only one place to fill in the 'maximal valid speed' and 'maximal valid acceleration' (Figure 11). These settings are thereafter used for both classifying sprints and accelerations.

Save and exit							
General							
Description Inmotio 2020-09	V Active						
Calculation options	Validation options	HML Distance					
Whole dataset between markers	Max. valid speed	10 ‡	m/s	Min. speed	5,56	m/s	
 Heartbeat rate only for 1 minute Calculate "Whole Exercise/Game" 	Max. valid acceleration	9 ‡ n	m/s²	Min. acceleration	2,000	‡ m/s²	
Add Bins to Summary	Sprint options	Sprint options			Heatmap options		
Splits Accel-Deceleration Bins	Min. sprint speed	m/s	Calculate heatmaps				
Speed in km/b	Min. sprint time	200 ‡	ms	Resolution	Small	-	
	Max. standing speed	4,167 ‡	m/s	Show labels	[
Zone parameters	Min. standing time	100 * m	ms	Heartheat			
Speed zones:	Min. HID speed		m/s	Heartbeat			
Absolute values 🔹	Chow sprints with high accol		1117.5	High intensity relative HB p	erc 85 ;	%	
Heartrate zones:	Starttime from begin part						
Relative to personal max +			1				
Acceleration zones:	HI Sprint category	5 ‡					
Absolute values *	Acceleration options						
	Min. acceleration	1,5 🛟	m/s²				
	Min. accel. time	500 💲	ms				
	Min. speed in accel.	2,778 1	m/s				
	Min. accel. time above speed	0 *	ms				
			1				

Figure 11. New place to fill in the 'maximal valid speed' and 'maximal valid acceleration'