Feif Sport Judges Seminar 2021

LAP and LAL

(…and a little bit more)

Elisabeth Jansen

Overview

- Gait definition
- Tölt and pace description
- LAP / LAL
- Studies on equine biomechanics
- Further reading/ youtube/ websides
- Discussion after break out rooms (zoom)

Gaits

- Gaits can be classified as patterns and timing of footfalls
- That is: coordination of the movements of the four limbs (Clayton, 2004)
- *A gait is a characteristic limb coordination pattern recognized by the sequence and timing of the footfalls*

- Locomotion *movement((is a loss of balance followed by hoof placement to establish a new base of support and regain balance

Stride

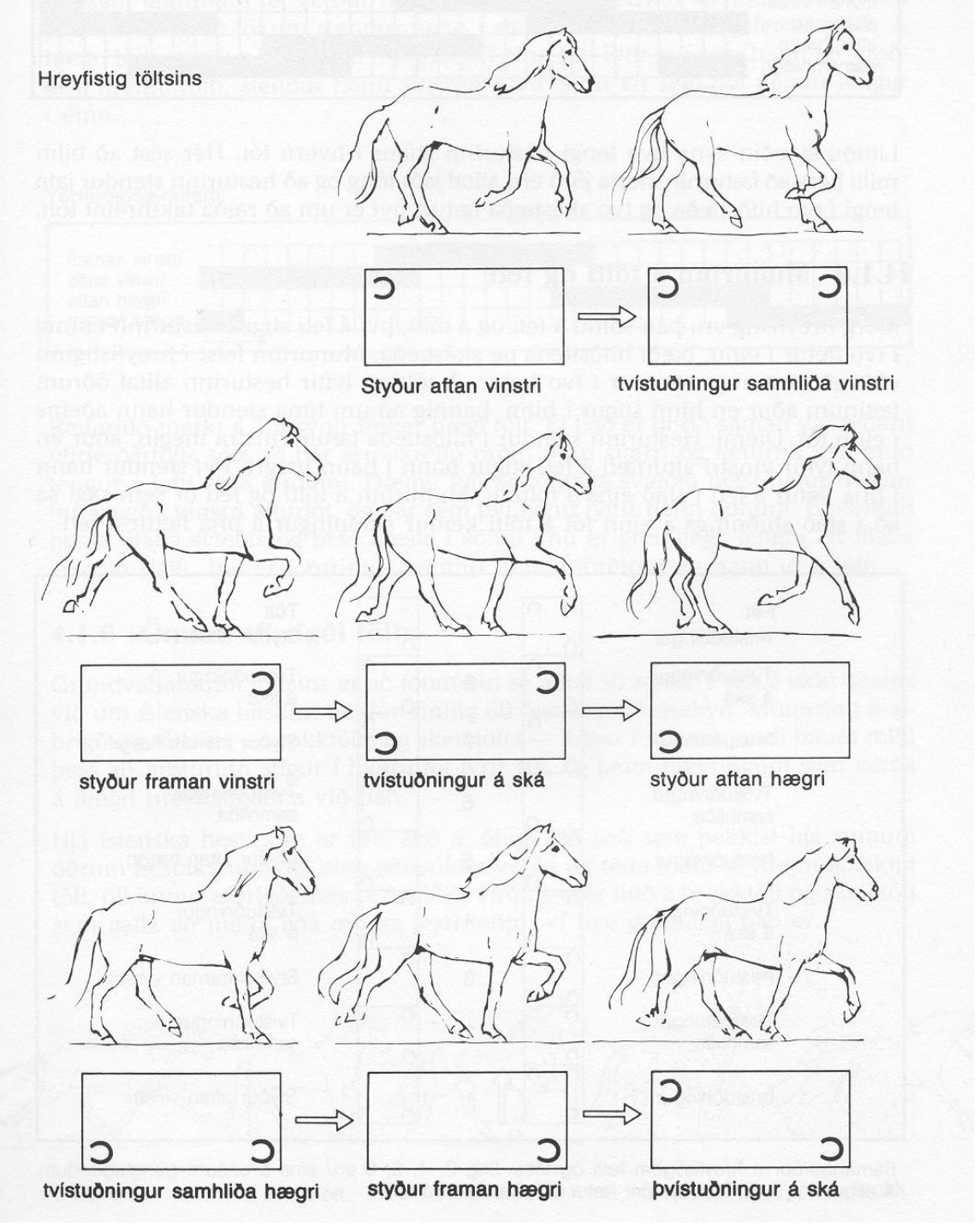
- Each gait has a unique inter limb coordination of the legs (stride cycle)
- A stride is a complete cycle of limb movements and each stride cycle consists of its own inter limb coordination
- The same pattern of limb movements is performed repeatedly, stride after stride
- One stride is referred to as a “unit” of a gait
- The stride is divided into :

1. Stance phase
2. Swing phase

(For each limb)

- **Tölt** is a symmetrical four-beat gait with lateral sequence of footfalls and eight phases.
- No suspension
- However, it has *transverse suspension (half suspension)* both in front and hind
- Therefor it is considered a **running gait**

- The support phases during the tölt stride alternate between **bipedal** (2 legs) and **unipedal** (1 leg) support.



transverse suspension (half-suspension)

50% hind

50% front

UNI (1 leg) pedal support

BI (legs) pedal *lateral* support


BI pedal
diagonal
support

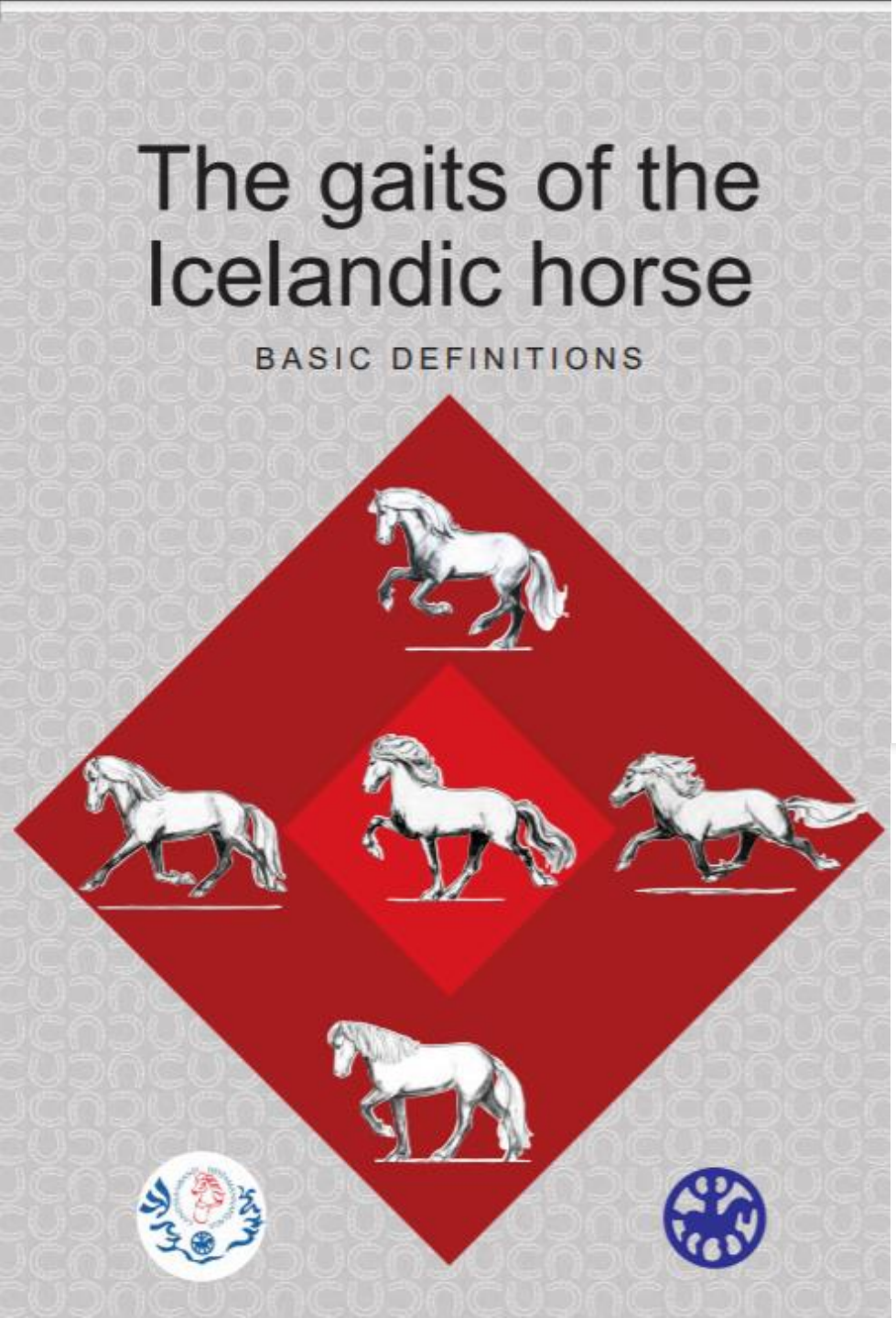

Unipedal
support
(hindleg)


Unipedal
support
(hindleg)

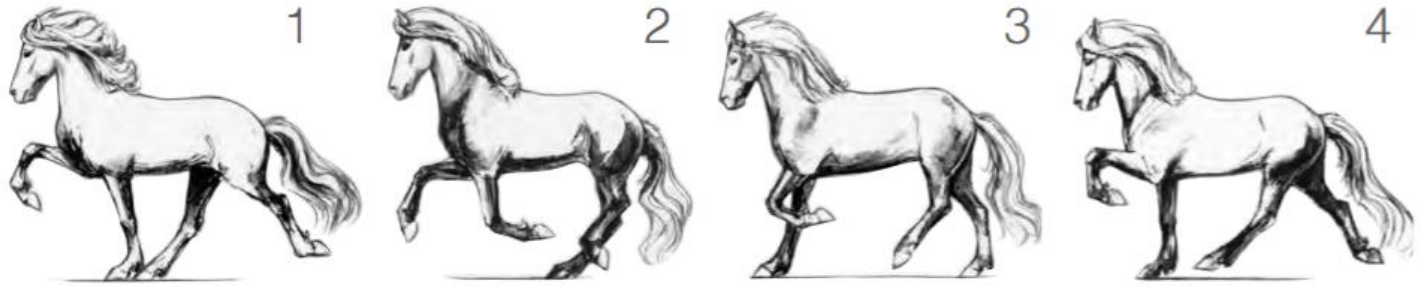

Lateral
bipedal
support


Unipedal
support
(front)


Lateral
bipedal
support



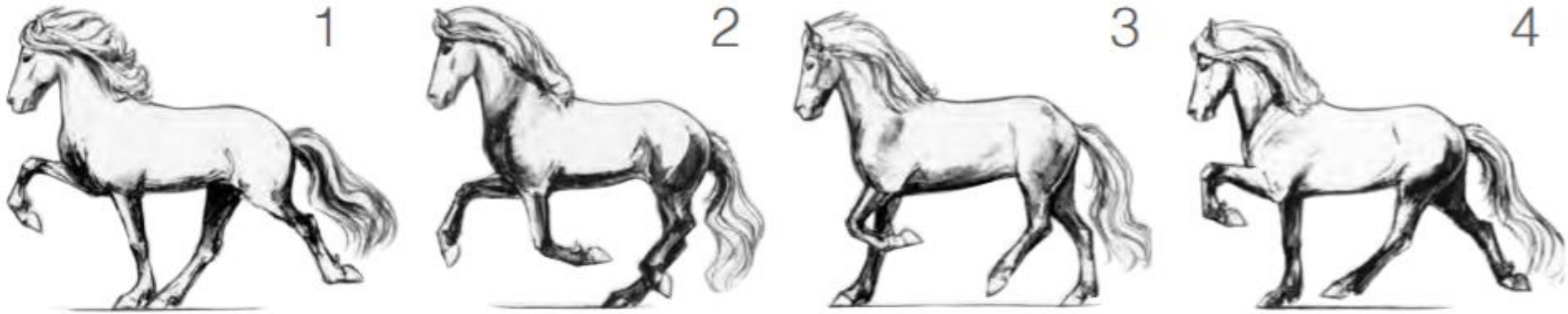
We as judges must update and educate our selves – please read this very fine document on Feif's home page:
https://www.feiffengur.com/documents/LH_gangtegundir_2017.pdf



The tölt is a four-beat gait with ipsilateral sequence of footfalls and eight phases. The footfall sequence is left hind leg – left foreleg – right hind leg – right foreleg. Ideally it should have a regular rhythm with even time interval between ground contacts of each limb. It is a gait without suspension. However, it has half-suspension, both in front (a moment where both front legs are in the air) and hind (a moment where both hind legs are in the air). The support phases during the tölt stride alternate between bipedal and unipedal support.

From the basic definition of the gaits

https://www.feiffengur.com/documents/LH_gangtegundir_2017.pdf



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Guidelines (slow tölt)

Slow TÖLT

General: The horse should go in an even four-beat rhythm, which runs fluently through the horse. The neck should be arched and the back active and rounded, the whole top-line being without tension. The hindquarters are well engaged, and the movements of the forequarters are light and free. The stance phase of the hind legs is longer than the stance phase of the front legs. The horse should move in balance, with strong and active back with suppleness and fluid movements.

	Poor performance					Low average performance			High average performance			Good performance			Excellent performance		
	0	0,5	**1**	1,5	**2**	2,5	**3**	3,5	**4**	4,5	**5**	5,5	**6**	6,5	**7**	7,5	**8**	8,5	**9**	9,5	**10**
Riding skills / Connection	Rough riding (warning by yellow card), very poor riding skills, serious lack of cooperation, very poor connection					Some clear faults in riding problems with the connection *The seriousness of the shortcoming should influence the mark*								Generally good riding style horse generally submitting to the riding aids				Harmony, very good connection, excellent riding			
Beat / Balance	Very poor beat, frequently losing the gait, very uneven strides							Beat or balance problems				Acceptable beat, occasional balance problems		Good beat, balance and rhythm even strides, gait consistency							
Suppleness / Relaxation	Very much stiffness or tension							Stiffness or tension Constrained in movements						Predominantly / reasonable supple				Very supple, elastic, unconstrained			

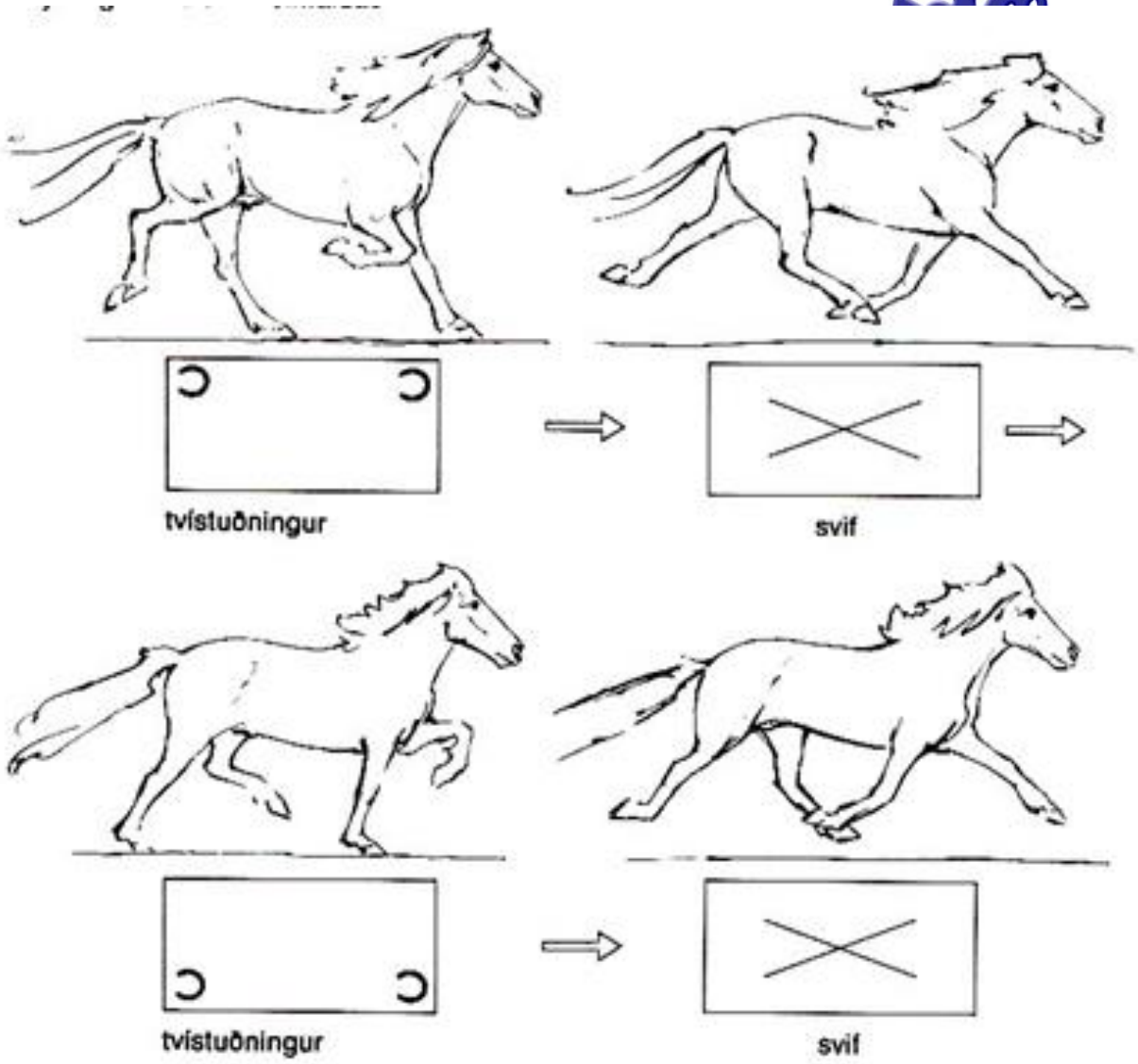
LAP (footfall = *beat*)

LAL (lift off = back *stiffness* / tension in the trunk/body

Pace

- Pace is a two beated lateral gait with suspension
- Pace is often *fourbeated* in the beginning of the run, especially if the horse is accelerating a lot (powerful)

Pace (speeding up, some fourbeat)



Same horse (an other test) later in the round, two beated

PACE – oval track

General: The horse should go in an energetic two-beat lateral rhythm with a clearly visible suspension and at high speed. The horse should lift its back and extend the head and neck forward. In the suspension-phase lateral front and hind legs are stretched far forward and the opposite legs are stretched far backward.

	Poor performance					Low average performance			High average performance			Good performance			Excellent performance		
	0	0,5	**1**	1,5	**2**	2,5	**3**	3,5	**4**	4,5	**5**	5,5	**6**	6,5	**7**	7,5	**8**	8,5	**9**	9,5	**10**
Riding skills / Connection	Rough riding (warning by yellow card) Very poor riding skills, serious lack of cooperation, very poor connection					Some clear faults in riding, Problems with the connection *The seriousness of the shortcoming should influence the mark*								Generally good riding style Horse generally submitting to the riding aids				Harmony Very good connection Excellent riding			
Beat / Balance	Very poor beat, very little suspension, very uneven strides.							Beat or balance problems, visible suspension				Acceptable beat, occasional balance problems		Good beat, balance and rhythm even strides, good suspension							
Suppleness / Relaxation	Very much stiffness or tension							Stiffness or tension Constrained in movements						Predominantly / reasonable supple				Very supple, elastic Unconstrained			

What is LAP and LAL?

LAP – *lateral advanced placement* (also referred to as *Lateral Dissociation at Contact)*

- LAP = 0 = pace
- LAP is less then < 19% = pacey tölt
- LAP is more than > 31% = trotty tölt
- LAP = 50% = trot

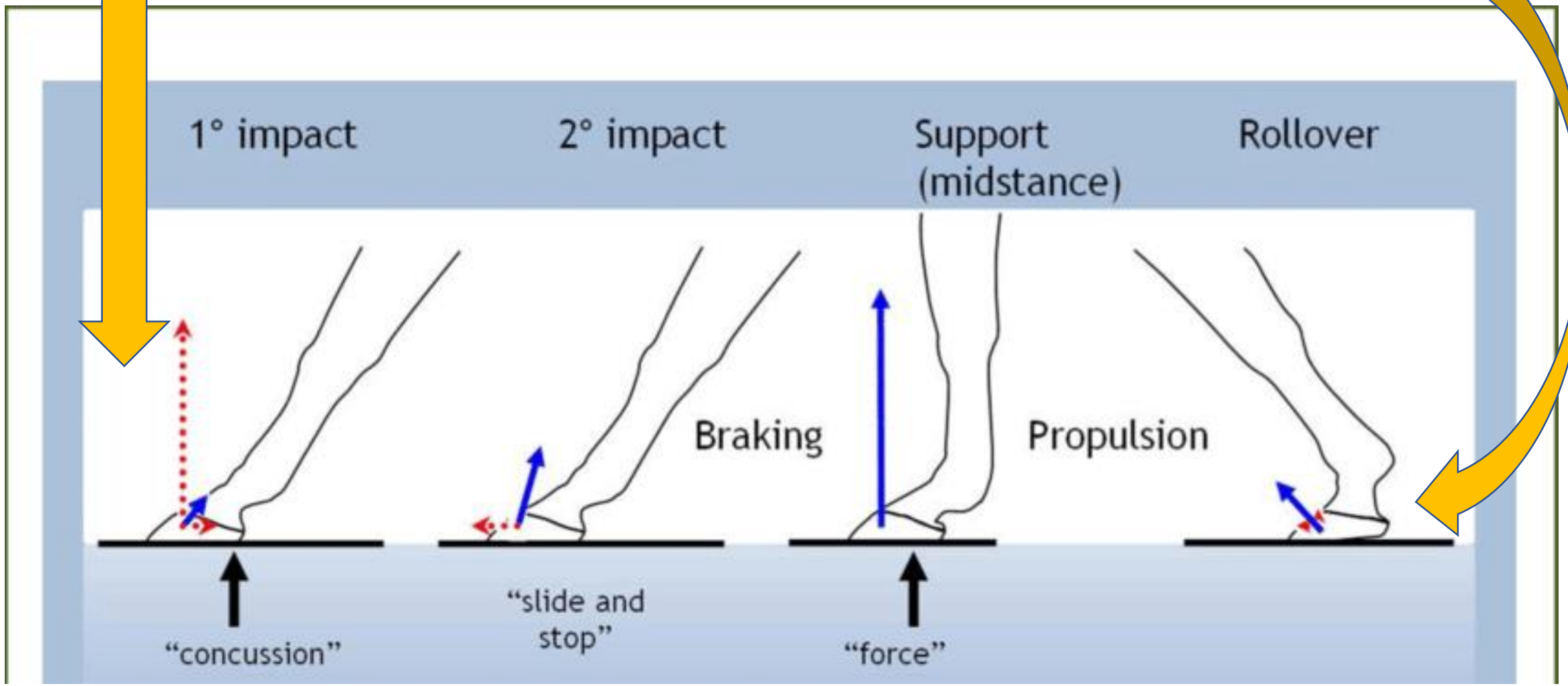
- Calculated using the footfall pattern of the lateral / diagonal couplets

LAL: *lateral advanced lift-off*

- Average lateral advanced lift off of the left and right side
- LAL is usually not 25% in a clear beated tölt, but needs more investigations to
- Duty factor (DF- how much the hind linbs carry compared to fronlegs) has an effect on LAL – more carrying on the hind (DF) can decrease the LAL (late lift of due to

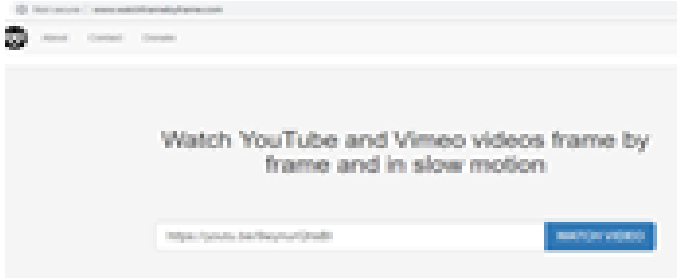
LAP (when landing)

LAL (when hoof lifts off)



How to work out LAP

Copy Youtube url into
www.watchframebyframe.com



Find 10 complete strides using slowest speed & 60fps (. = forwards , = backwards)
Time them e.g 1:14-6.72 so 10 strides take 5.58s, therefore 1 stride takes 0.558s

Work out time for each RH-RF & LH-LF
Work out the average RH-RF & LH-LF

Take avg of lateral pairs (0.115) and divide by avg stride (0.558) & x by 100 to find the LAP %
0.115/0.558 = 20.6%

strides	RH	RF		LH	LF	
1	1.14	1.28	0.14	1.41	1.56	0.15
2	1.73	1.83	0.10	1.99	2.09	0.10
3	2.29	2.39	0.10	2.56	2.66	0.10
4	2.82	2.92	0.10	3.09	3.19	0.10
5	3.35	3.49	0.14	3.62	3.72	0.10
6	3.92	3.99	0.07	4.19	4.32	0.13
7	4.49	4.59	0.10	4.76	4.89	0.13
8	5.02	5.16	0.14	5.32	5.42	0.10
9	5.59	5.72	0.13	5.89	5.99	0.10
10	6.16	6.29	0.13	6.39	6.52	0.13
11	6.72					
10 strides	5.58					
avg stride	0.558		0.115			0.114
				LAP	20.6%	

How to find the timing of the footfall:

00:18:99 / 03:35:56 1 frar 25 FF

Rhythm

- Can be explained as the flow of movement through the equine body
- The rythm is a result of many things but can be said that it is one of the effects of LAP and LAL
- The rider often disturbs the natural rhythm of the movements of the ridden horse by not be in the same rhythm as the horse.
- This can result in that the rider disrupt the horses' LAP and LAL and thereby the flow of movements (rhythm)

- A low LAL looks pacy due to a stiff back. It is natural that one lateral side of the horse looks "stiff" because the lateral pair of legs move (lift of) simultaneously.
- This can be different on the left and right side (sometimes lower LAL on one side and looks more "stiff" there)

Gait analysis

- Quantitative gait analysis can identify and **measure potential gait disturbances** in horses with musculoskeletal or neurological conditions.
- Its use in **aiding lameness diagnosis** and monitoring is mainly based on measuring **gait asymmetries**, determining whether those asymmetries are over pre-set thresholds and deciding on their clinical relevance.
- Much work has already been done to investigate symmetry and asymmetry values of the motion of various body parts (including vertical (up and down) displacement of head, withers and pelvis; joint angle parameters of the limbs and vertebral column), stride parameters and limb loading; as well as the symmetry values seen under different conditions such as different disciplines, training, type of terrain, with or without a rider and during lungeing or when moving over a straight line

Equine Veterinary Journal

Equine Veterinary Journal ISSN 0425-1644
DOI: 10.1111/evj.13162

Practical uses of quantitative gait analysis in horses

Practical Uses of Quantitative Gait Analysis Online Collection

Image: https://onlinelibrary.wiley.com/doi/10.1111/evj.12651

A free collection of recent Equine Veterinary Journal articles selected by Constanza Gomez Alvarez & René van Weeren

Full articles are available free online at: https://bit.ly/2m1JI3D

wileyonlinelibrary.com/journal/evj

OBJECTIVE EVALUATION OF STRIDE PARAMETERS IN THE FIVE-GAITED ICELANDIC HORSE

V. Gunnarsson[1], M. Tijssen[2], S. Björnsdóttir[3], J.P. Voskamp[4], P.R. Van Weeren[5], W. Back[2], M. Rhodin[6], E. Persson-Sjodin[6], F.M. Serra Bragança[5]

Conclusion

Valuable quantitative data for stride parameters of all 5 gaits of the Icelandic horse were collected in a field setting using IMU sensors. In combination with traditional subjective methods, this objective technique might enhance assessment of gait quality in competitions and breeding shows.

Background

At official breeding shows and in most competition disciplines for the Icelandic horse the main emphasis is on gait quality. So far the assessment of the gaits has only been based on subjective judging scales.

Aim

To provide quantitative data for temporal stride parameters for the five gaits of the Icelandic horse breed.

Results

Walk (715 strides):
Duty factor front limbs (DF-front) 62.6±0.09%, Duty factor hind limbs (DF-hind) 59.0±0.06%, Lateral advanced placement (LAP) 25.6±0.12%.

Trot (516 strides):
DF-front 43.9±0.18%, DF-hind 45.8±0.23%, suspension 3.5±0.22%, Diagonal advanced placement (DAP) - 4.9±0.19%.

Tölt (1218 strides):
DF-front 45.1±0.14%, DF-hind 44.8±0.12%, LAP 19.4±0.21%.

Pace (216 strides):
DF-front 35.7±0.28%, DF-hind 42.1±0.41%, suspension 9.9±0.56%, LAP 12.5±0.52%.

Canter (777 strides):
DF-front 39.3±0.14%, DF-hind 43.8±0.19%, suspension 7.1±0.22%.

An Icelandic stallion in tölt, equipped with IMU sensors.

Materials and methods

- Twenty-six Icelandic school horses, ridden by experienced riders, were equipped with inertial measurement unit (IMU) sensors (EquiMoves®) that were attached to each metacarpal/metatarsal bone and set to a sampling speed of 500Hz.
- A video camera was also synchronised with the IMU sensors.
- Representative strides (>200) for each gait were selected from the videos by a qualified judge and stride parameters were calculated in descriptive statistics in Minitab (2018) based on hoof-on and hoof-off IMU data on a stride per stride basis.
- Results were presented as mean ± SE for each gait.

Authors affiliation
[1]Hólar University College, 551 Sauðárkrókur, Iceland
[2] Utrecht University, 3508 Utrecht, the Netherlands
[3] Icelandic Food and Veterinary Authority, 800 Selfoss, Iceland
[4] Rosmark Consult, 6733 Wekerom, the Netherlands
[5] Ghent University, Merelbeke, 9820 Belgium
[6] Swedish University of Agricultural Sciences, Uppsala, Sweden

Analysis of movement in pace and tölt in the Icelandic horse
MSc Gunnar Reynisson, 2017

Scientific Reports | (2020) 10:17785 | https://doi.org/10.1038/s41598-020-73215-9 nature research 1

www.nature.com/scientificreports

scientific reports

Check for updates

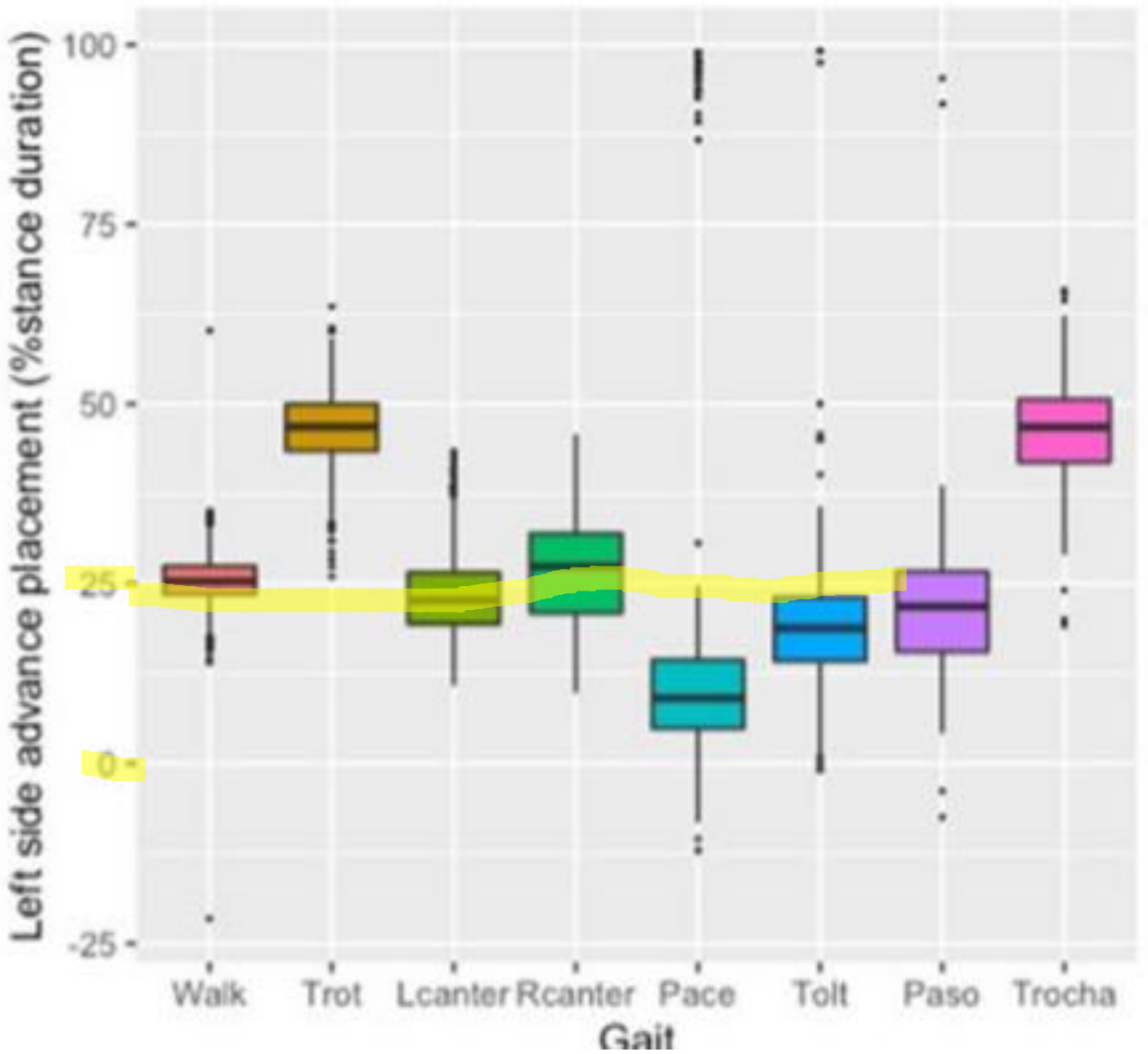
OPEN

Improving gait classification in horses by using inertial measurement unit (IMU) generated data and machine learning

F. M. Serra Bragança[1✉], S. Broomé[2], M. Rhodin[3], S. Björnsdóttir[4], V. Gunnarsson[5], J. P. Voskamp[1], E. Persson-Sjodin[3], W. Back[1,6], G. Lindgren[7,8], M. Novoa-Bravo[7,9], C. Roepstorff[10], B. J. van der Zwaag[11], P. R. Van Weeren[1] & E. Hernlund[3]

For centuries humans have been fascinated by the natural beauty of horses in motion and their different gaits. Gait classification (GC) is commonly performed through visual assessment and reliable, automated methods for real-time objective GC in horses are warranted. In this study, we used a full body network of wireless, high sampling-rate sensors combined with machine learning to fully automatically classify gait. Using data from 120 horses of four different domestic breeds, equipped with seven motion sensors, we included 7576 strides from eight different gaits. GC was trained using several machine-learning approaches, both from feature-extracted data and from raw sensor data. Our best GC model achieved 97% accuracy. Our technique facilitated accurate, GC that enables in-depth biomechanical studies and allows for highly accurate phenotyping of gait for genetic research and breeding. Our approach lends itself for potential use in other quadrupedal species without the need for developing gait/animal specific algorithms.

Scientific Reports | (2020) 10:17785 | https://doi.org/10.1038/s41598-020-73215-9 nature research



LAP % compared between some gaits (Filipe Bragança *et al.*,2000)

LIVE on Facebook

7.

ONSDAG 7. APRIL 2021 KL. 18:30 UTC–20:30 UTC

Understanding and Assessing Your Horse's Posture - A webinar with Gillian Higgins

Gratis · Online Event

Additional information

Hilary Clayton – youtube

- http://www.youtube.com/watch?v=jtjWo74NYNY
- http://www.youtube.com/watch?feature=endscreen&NR=1&v=lWmNprwPNlI

Gillian Higgins: VERY informative site: Horses inside out (she had lectures in London on the Feif seminar 2017):

- https://www.horsesinsideout.com/gallery-videos

PROMO Vet suisse Faculty Zurich Equine Performance Centre - Icelandic horses measurements

- http://www.youtube.com/watch?v=O1YxCGj1q4M

Horse gait Slow motion – trot

- http://www.youtube.com/watch?NR=1&feature=endscreen&v=venukXZggzc

Qualisys Motion Capture of a Horse and rider

- http://www.youtube.com/watch?v=wtWliY1yQXY

Here is an interesting web about the human vision:

- https://webvision.med.utah.edu/)

References

Back, W. and Clayton, H., 2001. *Equine Locomotion*

Clayton, H., 2004. Dynamic Horse.

Hildebrand, M., 1965. *Science*, *150(*3697) pp. 701-708

Nicodemus, M. and Hilary M. Clayton, H.M., 2003. Temporal variables of four-beat, stepping gaits of gaited horses. *Applied animal behaviour science, 80,* 133-142.

Horses to evaluate and judge

Watch the videos, **judge, give a score** and *think* about the LAP and the LAL *(no need to calculate)* AND other elements of the guidlines

Hreimur - T1

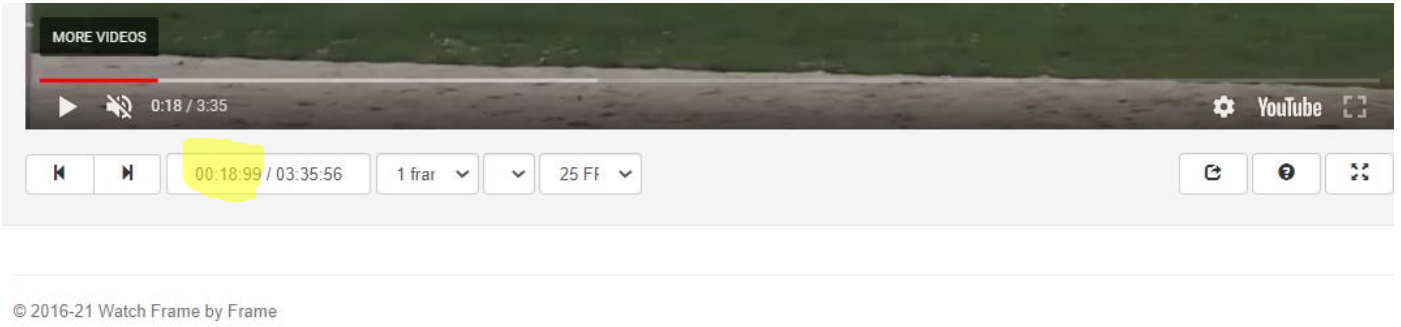
- Slow tölt
- Tempo changes
- Fast tempo tölt

Dreki - F1

- Tölt
- Pace (first long side)

Calculations

- LAL is calculated the same way as the LAP (just use timing of the LIFT –OFF instead of the hoof hitting the ground)
- You can use a software programe *Kinovea* (does not play youtube, you must download the videos into your compute) https://www.kinovea.org/download.html
- OR the youtube reader:
- http://www.watchframebyframe.com/



Feif sport
RESULTS ***after*** group discussion

Elisabeth Jansen

DREKI F1

- Tölt?
- Score:
- LAP/LAL?
- Pace
- Score

DREKI F1

https://www.youtube.com/watch?v=yuT_DcU-B2g&feature=youtu.be

Tölt:

LAP 19-20%

LAL: 11%

Score: 4,5 -5,5

Pace 1: LAP: in the beginning 18,4%

LAP in the end: 3%

LAL: (beginning) 13%

(Transition: -1 preparation –**lack of flow)**

Scores for 1st pace: 6,0 -1 = 5,0

Pace 2: LAP: 11,2% (only a few steps)

(Transition : -1 preparation –**lack of flow)**

Hemir T1

We will judge together in break out rooms:

- Slow
- Tempo changes
- Fast

- Other elements?

Hemir T1

https://www.youtube.com/watch?v=eJDUKkKyeFs&feature=youtu.be

SLOW Tölt:

- LAP: 24% good beat
- LAL: 12,5% (might explain the tendency of stiff back movements / body function)

Other elements: Stiff chain. „Problems with connection“ – bit/ chain, MUST be seen! Score 5,5

Tempo changes:

LAP (last long side when speeding up): 23,6%
LAL: 14,7%

Other elements: connection problems (slowing down – connection)

score 5,5

Fast tölt:

- LAP: 24,3 % on LONG side
- LAL: 17,1 % on LONG side
- LAP on *short* side and out of corner: 22,2 %
- LAL on short side/corner: 14,7 %

Other elements:

- **6,0** – good speed, ok beat. THE BIT – riding skills/ CONNECTION is the issue that's stops the score at the firewall in the guidelines

- *Conclusion*: Good beat and performance except from the stiff chain which leads to a maximum score due to the firewall in the riding skills / connection part of the guidelines

LAP and LAL calculated (just an example)

T1	Heimir TEMPO changes						
	LAP						
	stride	LH	LF	LEFT	RH	RF	RIGHT
total							
	1	31,97	32,12	**0,15**	32,23	32,36	**0,13**
	2	32,49	32,59	**0,10**	32,70	32,82	**0,12**
	3	32,93	33,04	**0,11**	33,17	33,29	**0,12**
	4	33,39	33,51	**0,12**	33,63	33,76	**0,13**
	5	33,88	33,99	**0,11**	34,09	34,23	**0,14**
	6	34,34	34,45	**0,11**	34,57	34,69	**0,12**
	7	34,77	34,91	**0,14**	35,03	35,17	**0,14**
	8	35,24	35,39	**0,15**	35,49	35,63	**0,14**
	9	35,75	35,87	**0,12**	35,97	36,10	**0,13**
	10	36,69	36,82	**0,13**	**36,92**	37,04	**0,12**
	average			**0,12**			**0,13**
	min			**0,10**			**0,00**
	max			**0,15**			**0,00**
	average L+R		0,13				
	LAP		**23,59**				

T1	Heimir TEMPO changes						
	LAL						
	stride	LH	LF	LEFT	RH	RF	RIGHT
total							
	1	32,17	32,23	**0,06**	32,40	32,47	**0,07**
	2	32,64	32,70	**0,06**	32,88	32,93	**0,05**
	3	33,10	33,20	**0,10**	33,35	33,40	**0,05**
	4	33,57	33,63	**0,06**	33,80	33,87	**0,07**
	5	34,49	34,57	**0,08**	34,72	34,82	**0,10**
	6	34,96	35,03	**0,07**	35,19	35,29	**0,10**
	7	35,42	35,50	**0,08**	35,67	35,72	**0,05**
	8	35,75	35,90	**0,15**	36,12	36,23	**0,11**
	9	36,87	36,93	**0,06**	37,11	37,20	**0,09**
	10	37,35	37,44	**0,09**	37,60	37,70	**0,10**
	average			**0,08**			**0,08**
	min			**0,06**			**0,05**
	max			**0,15**			**0,11**
	average L+R		0,08				
	LAL		**14,74**				