Evidence based classification in Para-Badminton

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Project

Classes

Steps

1. Standing Classes (SL3 / SL4)

Video-Analysis: Matches

=> results

Performance-Analysis: Movements

=> results

2. Wheelchair Classes (WH1 / WH2)

Video-Analysis: Matches

=> results

Performance-Analysis: Movement

=> results

Border-Liner

...some remarks…

A sequential 4-step process that outlines how to initiate and develop evidence-based methods of classification is:

(1) specification of impairment types that are eligible for the sport;

(2) development of valid measures of impairment(s);

(3) **development of standardized, sport-specific measures of performance**; and

(4) **assessment of the relative strength of association between measures of impairment and measures of performance** *(Tweedy, Beckman & Connick, 2014)*

Classification	Typical examples of impairments
Wheelchair WH1	Spinal injury causing impairment to upper limbs/thunk; Scoliosis; Multiple Sclerosis
Wheelchair WH2	Spinal injury causing impairment to lower limbs/thunk; Spina Bifida; Above knee amputation necessitating need for wheelchair
Standing SL3	**Single above knee amputation; Double below knee amputation; Cerebral palsy**
Standing SL4	**Single below knee amputation; Cerebral Palsy; Hip dysplasia; Leng length difference (of minimum 70 mm)**
Standing SU5	Upper limb amputation; upper limb impariment – eg. Brachial plexus injury
Short stature SS6	Short stature/dwarf condition eg. achondraplasia

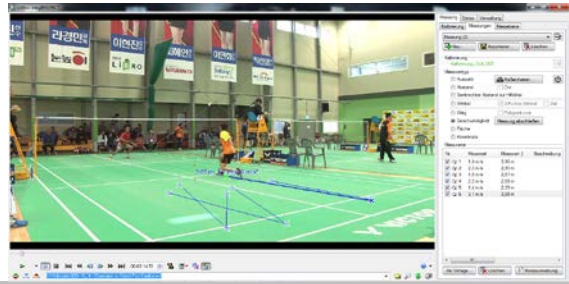
Standing
Video-Analysis

Following questions should be answered:

- What are the **average distances** during SL3 and SL 4 in a rally ?

- What is the **average velocity** during SL3 and SL 4 in a rally ?

➢ Are there any differences in distance and velocity in a SL3 and SL4 in a rally ?



	Dictance (m) coverd in a rally	Average velocity (m/s) in a rally	Maximum velocity (m/s) in a rally	Duration (sec) rally (matches + tests)	Duration (sec) breaks (matches and tests)
SL3 (n= 145)	81,8	1,3	2,3	12.4	13.5
SL4 (n= 167)	94,5	1,6	2,8	16.3	12.5
p - Value	0.46	0.00169	0.00158	0.00021	0.78
Significance between SL3-SL4	No	**Yes**	**Yes**	**Yes**	No

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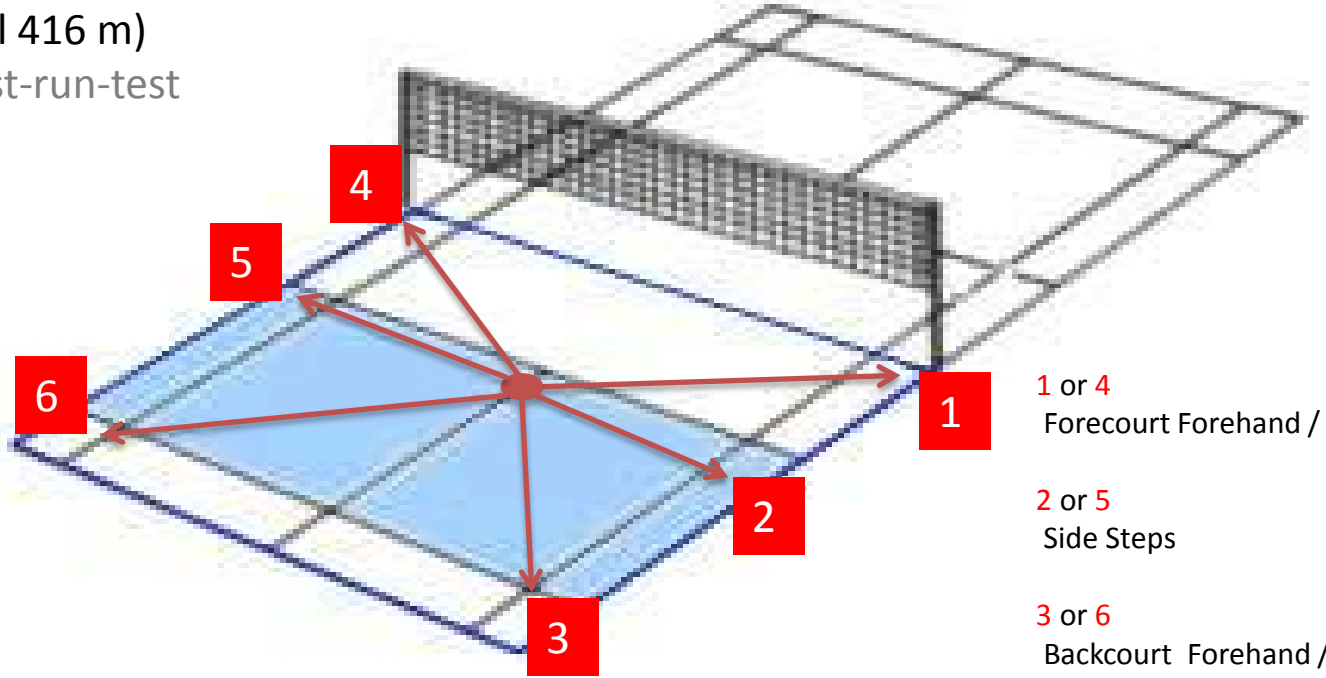
Standing
Performance-Analysis

The project aims to measure the amount of **accelation(s)** with a disability experience **(*sport-specific measures of performance*)** when moving through the court and to see how this relates to classification…

Tests:

- In-field-test: 20 different random sprints (129 to 143 m: total 416 m)
- Shuttle run test-run-test



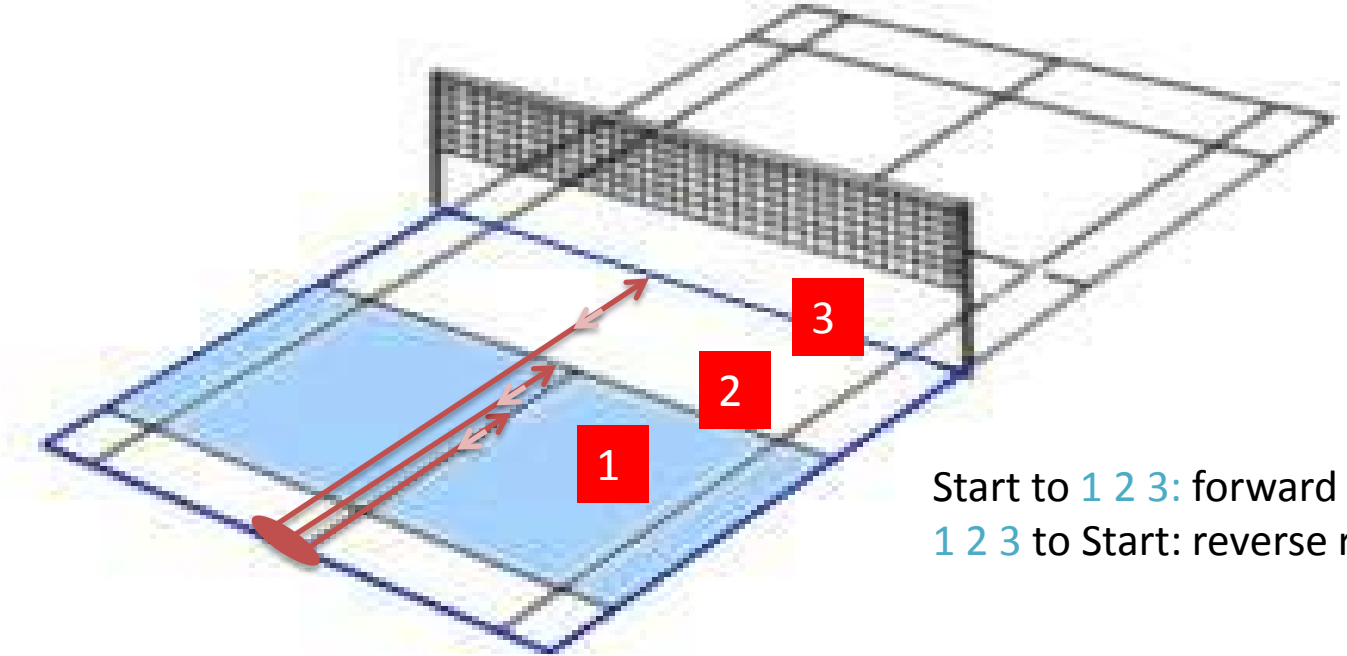
1 or 4
Forecourt Forehand / Backhand

2 or 5
Side Steps

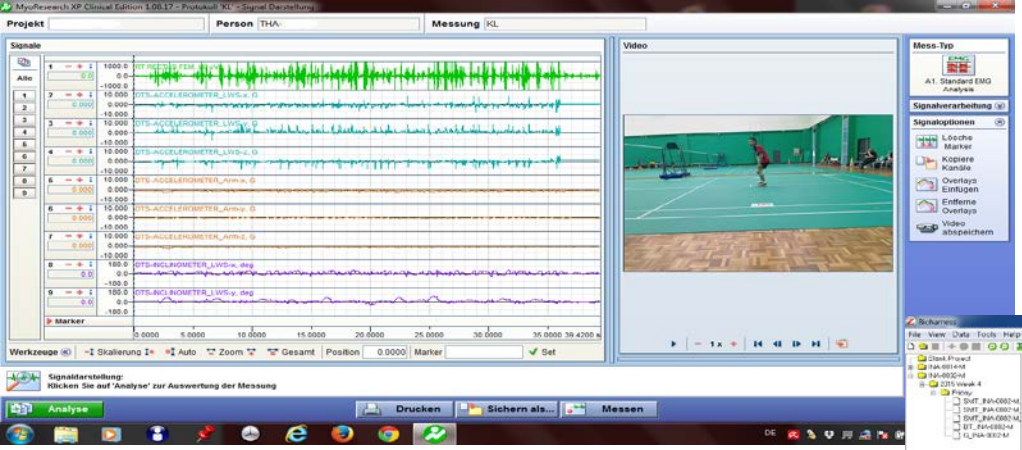
3 or 6
Backcourt Forehand / Backhand

Tests:

- In-field-test: 20 different ramdom sprints
- Shuttle-run-test (total 45 m)

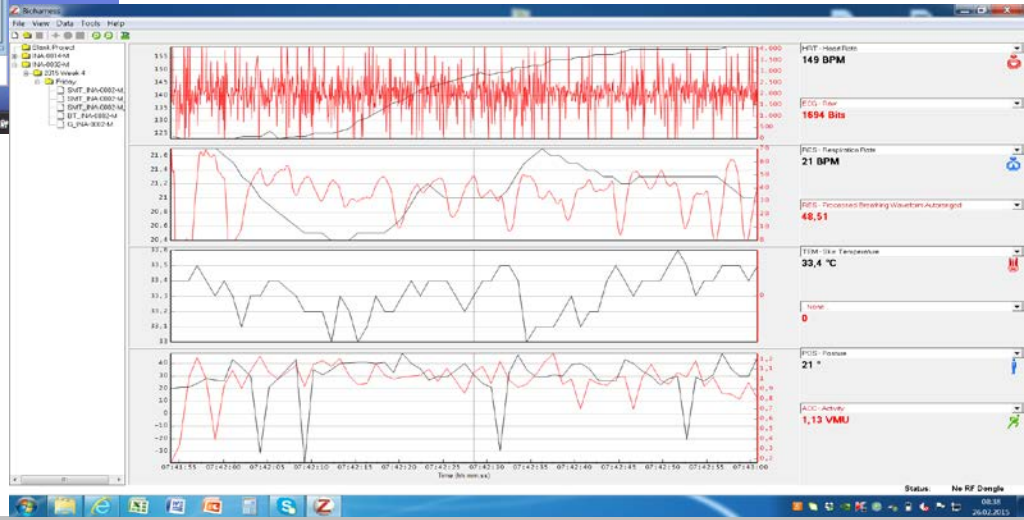


Start to 1 2 3: forward run
1 2 3 to Start: reverse run



Biomechanical Parameters:

- Activity / agility during movements
- Accelerations (x y z of the trunk)
- Accelerations (x y z of the dom arm)
- Angles of the trunk



Biological Parameters:

- Heart rate (HR)
- Heart rate Variability (HRV)
- Respiration rate (BPM)
- Surface (skin) temperature
- EMG from several muscles

Project Classes **Step1** Step2 Border-Liner

1. Standing Classes:

Video-Analysis: Matches

Performance Analysis

Results

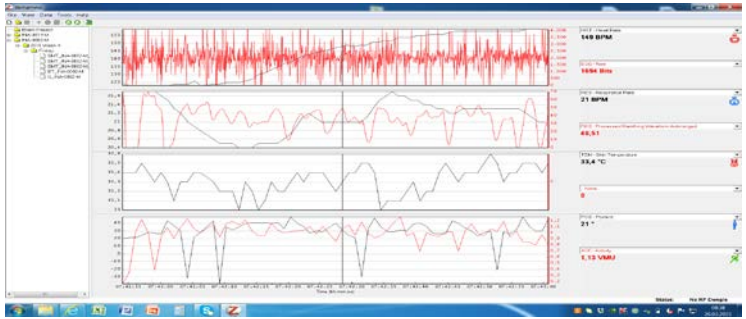
2. Wheelchair Classes

Video-Analysis: Matches

Performance Analysis

Results

Heart-rate:	155 – 187 BPM during match
Respiration-rate:	24 – 47 BPM during match
Temperatur increase during tests:	1.1 – 1.6 degrees
Neuromuscular fatique:	21 % (start to end of tests)



⇒ In total:

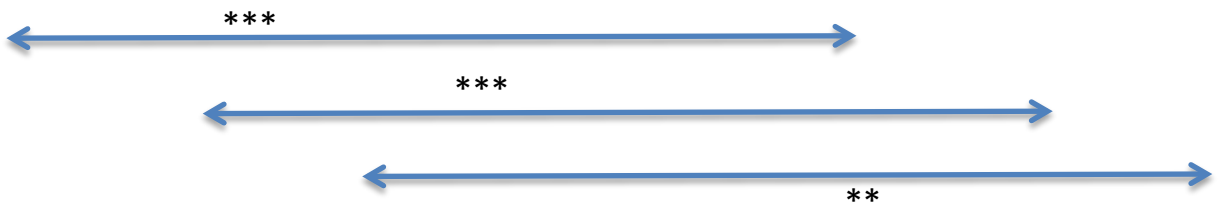
NO statistical differences between SL3 and SL4

Forecourt Forehand SL3			
Ratings given by classifiers	Max. Acc. Y	Max. Acc. Z	total
2	2,20	0,95	3,15
4	1,94	1,29	3,23
4	2,29	1,56	3,85
3	1,64	0,93	2,57
3			
3	1,30	1,04	2,34
2	0,20	0,21	0,41
3	1,23	0,34	1,57
r =	0,52		
	r =	0,84	
r =		0,71	
r =			0,62

Forecourt Forehand SL$			
Ratings given by classifiers	Max. Acc. Y	Max. Acc. Z	total
4	0,45	0,69	1,14
5	0,23	0,26	0,49
3	0,28	0,25	0,53
5	0,50	0,25	0,75
5	0,33	0,34	
5	0,22	0,33	0,55
5	0,24	0,41	0,65
5	0,39	0,32	0,71
5	0,26	0,39	0,65
5			
r =	0,17		
	r =	-0,59	
r =		0,55	
r =			0,62

Forecourt Backhand SL3			
Ratings given by classifiers	Max. Acc. Y	Max. Acc. Z	total
3	1,93	0,99	2,92
4	1,94	1,36	3,30
3	2,33	1,84	4,17
3	1,56	0,93	2,49
2			
3	1,20	0,88	2,08
3	0,19	0,24	0,43
2	1,13	0,35	1,48
r =	0,33		
	r =	0,90	
r =		0,53	
r =			0,43

Forecourt Backhand SL4			
Ratings given by classifiers	Max. Acc. Y	Max. Acc. Z	total
4	0,42	0,98	1,40
4	0,20	0,44	0,64
3	0,30	0,26	0,56
5	0,50	1,30	1,80
5	0,33	0,41	
4	0,23	0,40	0,63
5	0,21	0,30	0,51
4	0,33	0,31	0,64
4	0,28	0,41	0,69
4			
r =	0,27		
	r =	0,86	
r =		0,47	
r =			0,51



Backcourt Forehand SL3			
Ratings given by classifiers	Max. Acc. Y	Max. Acc. Z	total
2	1,64	0,68	2,32
3	2,30	1,69	3,99
4	1,78	1,40	3,18
3	1,70	0,61	2,31
3			
2	1,67	1,21	2,88
2	0,19	0,14	0,33
3	1,43	0,64	2,07
r =	0,46		
	r =	0,83	
r =		0,49	
r =			0,49

Backcourt Forehand SL4			
Ratings given by classifiers	Max. Acc. Y	Max. Acc. Z	total
3	1,35	0,57	1,92
4	0,17	0,23	0,40
3	0,27	0,20	0,47
4	0,34	0,35	0,69
4	0,37	0,44	
3	0,29	0,35	0,64
4	0,27	0,30	0,57
5	0,55	0,30	0,85
4	0,27	0,34	0,61
3			
r =	0,78		
	r =	0,14	
r =		0,25	
r =			0,79

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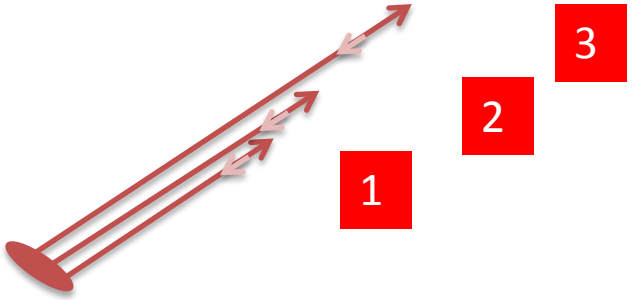
Project Classes **Step1** Step2 Comming Soon

1. Standing Classes:
Video-Analysis: Matches
Performance Analysis
Results

2. Wheelchair Classes
Video-Analysis: Matches
Performance Analysis
Results

Fast Foreward SL4		Fast Reverse SL4	
Ratings given by classifiers	Max. Z	Ratings	Max. Z
4	0,57	3	0,5
5	0,3	5	0,27
4	0,23	3	0,17
5	0,93	4	0,85
5	0,55	5	0,43
4	0,42	4	0,35
5	0,35	5	0,3
4		3	
5	0,38	3	0,2
5	0,97	4	1,02
r =	0,5	r =	0,1



	Classifikation		
K-Means	SL 3	SL 4	n
Cluster 1	3	6	9
Cluster 2	5	4	9

Conclusions

- significant differences in ***Acceleration*** (y and z direction: max and average) between SL3 and SL4

- Good correlations (0.70 to 0.75) between ***Max Accelation*** (y , z and total) and Ratings for all directions within SL3 and SL4

- Better correlations (0.78 to 0.83) between ***Average Acceleration*** (y, z and total) and Ratings for all directions within SL3 and S 4

➢ **there are good relationships between the rating-system and the measured values (accelerations) from the tests and significant differences between SL3 and SL4**

Wheelchair Video-Analysis

Following questions should be answered:

- What are the average distances during WH1 and WH2 rally ?

- What is the average velocity during WH1 and WH2 rally ?

➢ Are there any differences in velocity in a WH1 and WH2 rally ?

player 1

	distance [m]	velocity [m/s]
-1	17,97	0,9±0,3
Vmax		1,18
Vmin		0,42
-2	10,62	0,86±0,38
Vmax		1,28
Vmin		0,42

player 2

	distance [m]	velocity [m/s]
-1	84,86	0,94±0,4
Vmax		1,92
Vmin		0,26
-2	49,91	1,04±0,3
Vmax		1,84
Vmin		0,48
-3	17,52	0,78±0,4
Vmax		1,4
Vmin		0,34

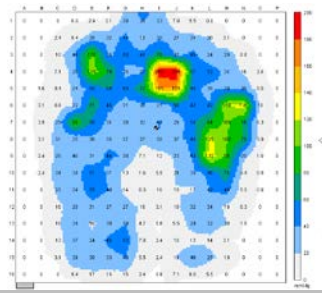
Wheelchair Performance-Analysis

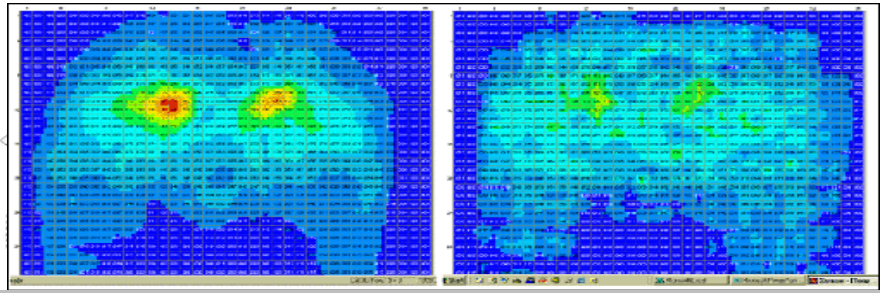
(comming soon)

Tests:
- In-field-test
- Shuttle-run-test
- match

Biomechanical Parameters:
- Activity / agility during movements
- Accelerations (x y z of the trunk)
- Accelerations (x y z of the dom arm)
- Angles of the trunk
- **COP**

Biological Parameters:
- Heart rate (HR)
- Heart rate Variability (HRV)
- Respiration rate (BPM)
- Surface (skin) temperature
- EMG from serveral muscles





Additionally, the project **aims to identify individual** performance parameters

- from video analysis of the match /
- from data from the tests

with physical disabilities or functional classification profiling, regarding key variables / ranges from individual distances, times, velocities and accelerations

=> for the **Border-Line**r problem

SL3		FF			
		Max. Acc. Y		Max. Acc. Z	
		Min	Max	Min	Max
very difficult	1				
difficult	2	0,2	2,2	0,21	0,95
sometimes easy sometimes difficult	3	1,23	1,64	0,5	1,04
easy	4	1,94	2,29	1,29	1,56
very easy	5				

larger
ranges / higher values

SL4		FF			
		Max. Acc. Y		Max. Acc. Z	
		Min	Max	Min	Max
very difficult	1				
difficult	2	0,1	0,28	0,17	0,34
sometimes easy sometimes difficult	3	0,25	0,45	0,28	0,25
easy	4	0,4	0,8	0,25	0,69
very easy	5				

smaller
ranges / minor values

The idea / proposal: in the case of doubts / disputes between SL3 and SL4 (= Border-Liners):
=> Recommendation of measurements with an objective system / device (eg acceleration measurements) and comparison / placement of the measured values based on the ranges

Thanks for your attention

...one team - one common goal...