Centro Studi Ricerca e Formazione FICK

SEMINARIO DI AGGIORNAMENTO ALLENATORI E MAESTRI 2015

Dispositivi per la valutazione posturale statica e dinamica del canoista

Castel Gandolfo 7-8 febbraio 2015
HOTEL VILLA DEGLI ANGELI

PhD Stefano Vando

Premessa

Durante il percorso Dottorale ho sviluppato una ricerca inerente sistemi applicativi e dispositivi LowCost per la valutazione funzionale in medicina riabilitativa e nello sport;

- Nel 2011 ispirandomi alle tecnologie Nintendo ho realizzato il software CoreMeter, per il controllo dei dispositivi Wii Balance Board e WiiMote;

- Nel 2012 ho brevettato il MarkWiIR, un dispositivo ad infrarossi per l'analisi cinematica 2D del movimento;

- Nel 2013 ho brevettato il SeatSensor, seggiolino con sensori di forza per l'analisi posturale del canoista;

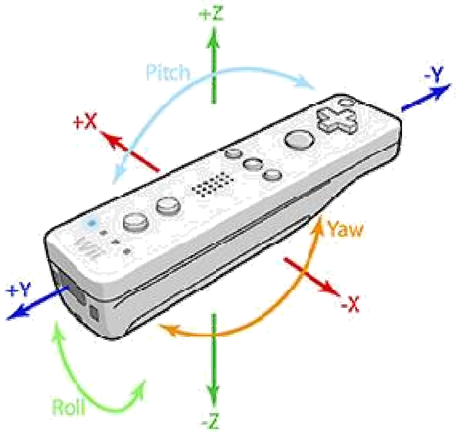
- Nel 2015 ho ricevuto la nomina come "Collaborazione tecnologica" per i settori Velocità, Maratona e Paracanoa FICK.

Lo sapevate che?....

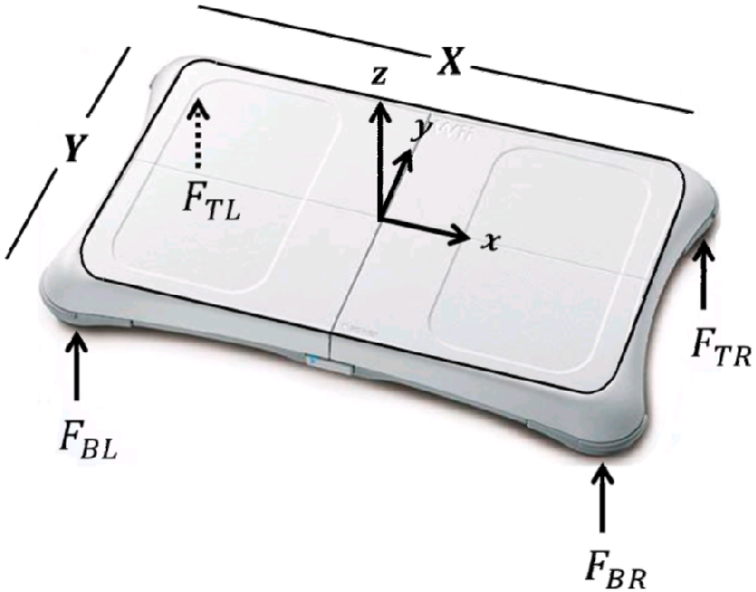
Un semplice gioco…

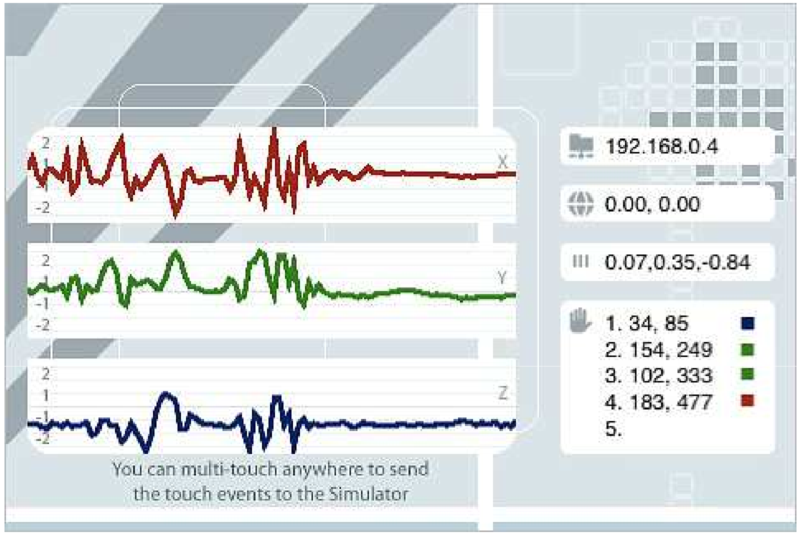
Si trasforma in strumento di misurazione

Accelerometro Triassiale



Pedana di forza Monoassiale

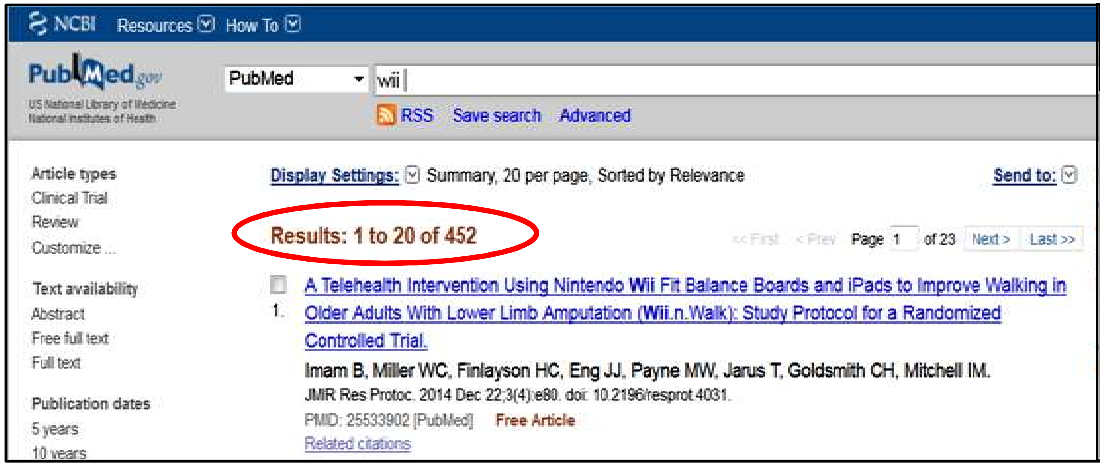




Caratteristiche tecniche:

- Frequenza: ~100 Hz
- Trasmissione dati: via Bluetooth
- Alimentazione: batterie 1,5 Volt

Tecnologie LowCost in crescita



anni	articoli	articoli/anno	articoli/mese
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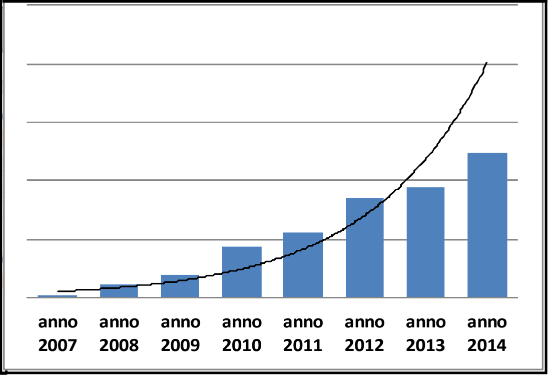

Validity and reliability of the Nintendo Wii Balance Board for assessment of standing balance

Ross A. Clark [a,*], Adam L. Bryant [a], Yonghao Pua [b], Paul McCrory [a], Kim Bennell [a], Michael Hunt [a]

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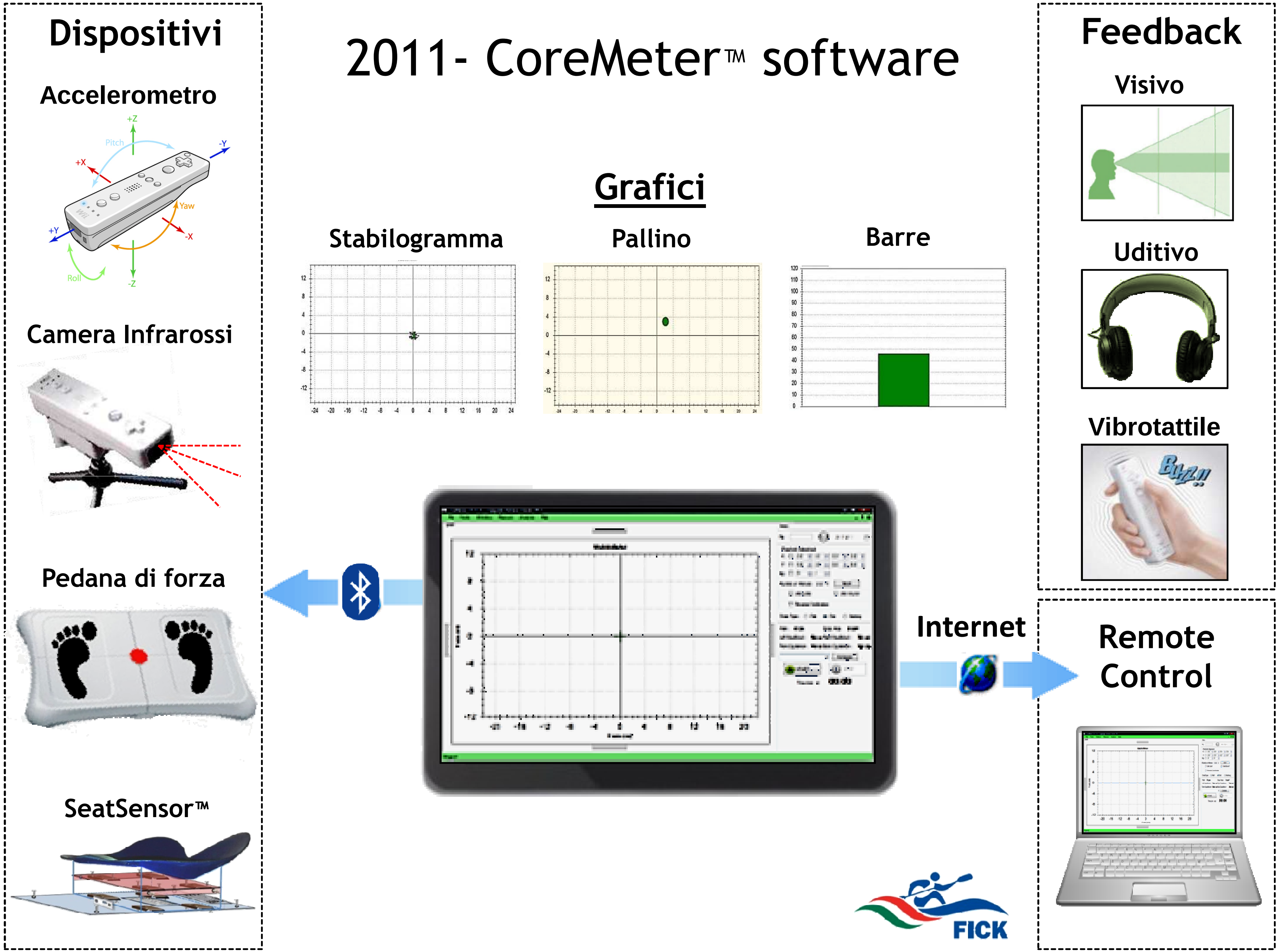
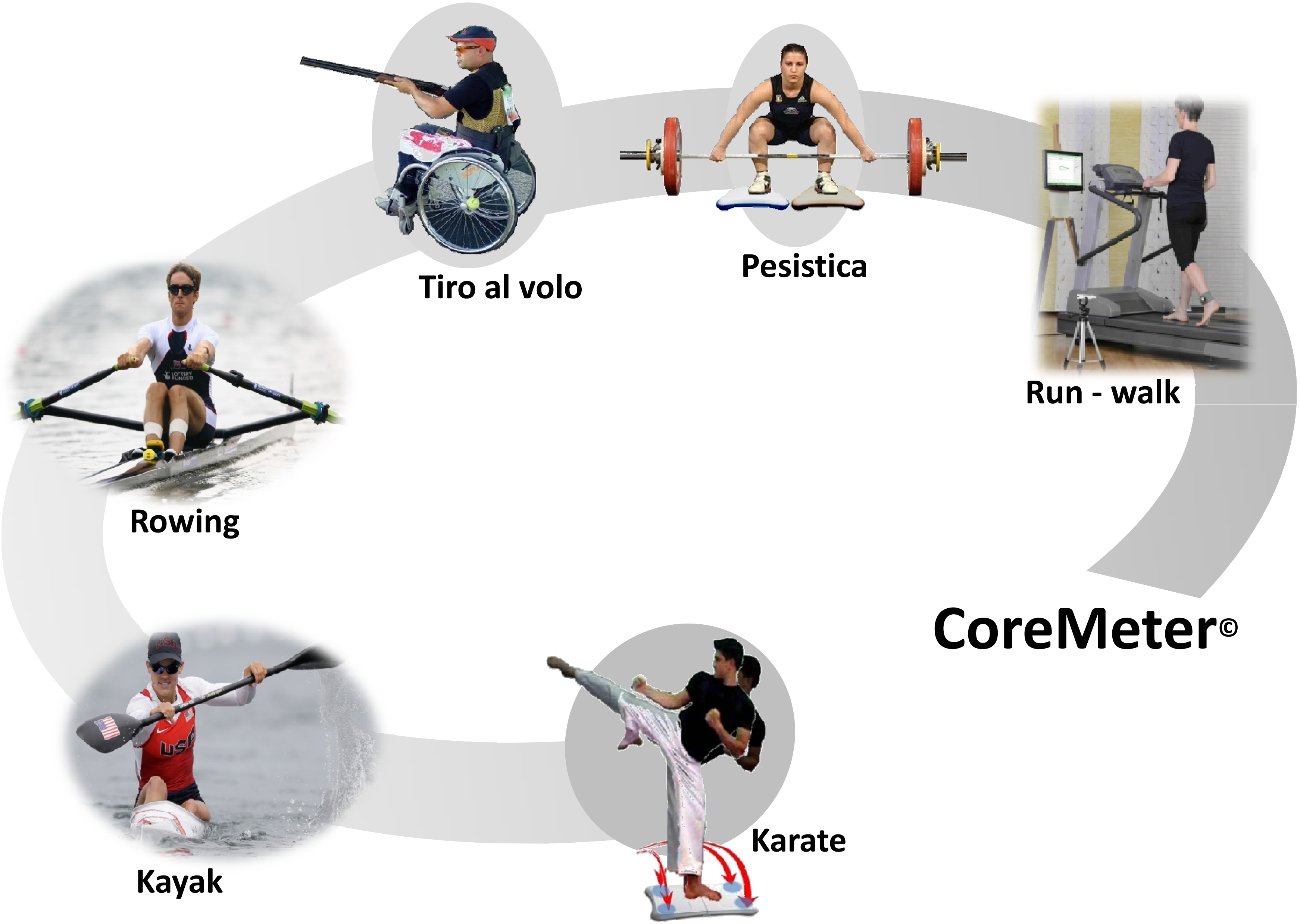
ABSTRACT

Impaired standing balance has a detrimental effect on a person's functional ability and increases their risk of falling. There is currently no validated system which can precisely quantify center of pressure (COP), an important component of standing balance, while being inexpensive, portable and widely available. The Wii Balance Board (WBB) fits these criteria, and we examined its validity in comparison with the 'gold standard'—a laboratory-grade force platform (FP). Thirty subjects without lower limb pathology performed a combination of single and double leg standing balance tests with eyes open or closed on two separate occasions. Data from the WBB were acquired using a laptop computer. The test–retest reliability for COP path length for each of the testing devices, including a comparison of the WBB and FP data, was examined using intraclass correlation coefficients (ICC), Bland–Altman plots (BAP) and minimum detectable change (MDC). Both devices exhibited good to excellent COP path length test–retest reliability within-device (ICC = 0.66–0.94) and between-device (ICC = 0.77–0.89) on all testing protocols. Examination of the BAP revealed no relationship between the difference and the mean in any test, however the MDC values for the WBB did exceed those of the FP in three of the four tests. These findings suggest that the WBB is a valid tool for assessing standing balance. Given that the WBB is portable, widely available and a fraction of the cost of a FP, it could provide the average clinician with a standing balance assessment tool suitable for the clinical setting.


Dispositivi
Accelerometro
Pitch
Yaw
Roll
+Z
-Z
+X
-X
+Y
-Y
Camera Infrarossi
Pedana di forza
SeatSensor™
2011- CoreMeter™ software
Grafici
Stabilogramma
Pallino
Barre
Internet
Feedback
Visivo
Uditivo
Vibrotattile
Remote Control
FICK

Applicazioni nello sport



2012 - Dispositivo per la cinematica 2D

RELIABILITY AND VALIDITY OF THE MARKWIIR™ FOR GAIT ANALYSIS

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[2]*Faculty of Sport Science, University of Federico II Napoli, ITALY*
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Introduction

The origins of the kinematic began with Edward James Muybridge, who in 1878 photographed a horse during a the race, while Etienne Jules Marey (Luderitz 2005) was the first to use a system of "markers" for the determination of the movements" kinematics. The Wii Remote™ senses light from the console's Sensor Bar (model number RVL-014) that have four infrared LEDs. The technology supporting this device can potentially be used to study the kinematics inverting the way in which it is used. Indeed, the Wii Remote™ can be fixed and the active marker can be attached to a body part that is free to move and thus give the possibility to study the kinematic. Hence, the aim of the present study was to validate the new infrared-LED MarkWiiR™ (MW) comparing it with the high-frequency video analysis while studying the kinematics of walking and running at different speeds.

Methods

Participants: Ten male students took part to the study (age 24.71 ± 3.99 years; body mass 60.14 ± 7.63 kg, height 1.68 ± 0.09 m; BMI 21.10 ± 2.01 kg/m2

Procedure: After warm-up, the experiment started with the subjects walking at different speeds from 1 to 6 km·h-1 and running from 10 to 13 km·h-1 6 on the treadmill at zero level with 1 minute of passive recovery between sets

References

-Clark RA, Bryant AL, Pua Y, McCrory P, Bennell K, Hunt M. (2010). Gait Posture, 31,307-310.
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Figure 1

Postural sway assessment
A. Bipodalic
B. Monopodalic

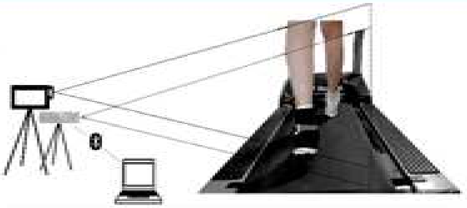
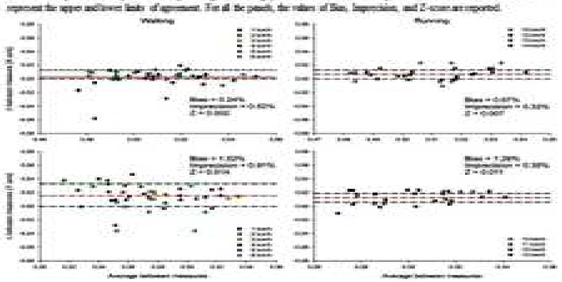


Table 1 Comparison of data (mean±SD) recorded at the pre and post-test between the two groups.

Velocity (km·h⁻¹)	x-axis Bias	Imprecision	LoA+	LoA-	Z	y-axis Bias	Imprecision	LoA+	LoA-	Z
1	0.181%	1.450%	2.985%	-2.623%	0.422	2.208%	0.962%	4.094%	0.322%	7.650
2	0.020%	0.669%	1.331%	-1.291%	0.208	2.489%	1.088%	4.827%	0.557%	8.240
3	0.725%	0.450%	1.580%	-0.154%	5.531	1.394%	0.669%	2.704%	0.083%	6.948
4	-0.651%	2.104%	3.474%	-4.775%	-1.051	1.173%	1.882%	4.861%	-2.514%	2.080
5	0.437%	0.395%	1.210%	-0.337%	3.687	1.599%	1.075%	3.705%	-0.508%	4.958
6	0.721%	0.309%	1.330%	0.108%	7.680	0.082%	2.300%	4.820%	-4.355%	0.088
Walking	0.237%	0.518%	1.252%	-0.778%	0.882	1.521%	0.896%	3.296%	-0.236%	0.014
10	0.470%	1.383%	3.087%	-4.836%	2.110	1.605%	0.712%	3.005%	0.208%	7.100
11	0.985%	0.344%	1.629%	0.203%	9.262	0.788%	1.255%	3.229%	-1.692%	2.041
12	0.225%	0.405%	1.015%	-0.566%	1.886	1.298%	0.890%	3.043%	-0.446%	4.880
13	0.626%	0.625%	1.851%	-0.609%	3.280	1.508%	0.913%	3.348%	-0.432%	4.958
Running	0.671%	0.328%	1.314%	0.027%	0.087	1.257%	0.352%	1.947%	0.568%	0.011
Locomotion	0.422%	0.482%	1.368%	-0.540%	0.010	1.415%	0.728%	2.824%	0.007%	0.010

Percentage of bias, imprecision (standard deviation of the bias), upper (LoA+) - lower (LoA-) limits of agreement, Z-score value for each speeds (1 to 13 km·h-1), mean of walking (1 to 6 km·h-1), running (10 to 13 km·h-1) and overall mean of speeds (Locomotion).

Figure 2 Bland-Altman plots of x and y dimensions of walking and running speeds. The continuous line represents the bias while the dashed lines represent the upper and lower limits of agreement. For all the panels, the values of Bias, Imprecision, and Z-score are reported.



Results

As a gold standard, a High frequency camera (Casio FH20) with an acquisition sampling frequency of 210-Hz was used. The new device studied consisted of two parts: an Infrared-LED MarkWiiR ™ (MW) and a Nintendo Wii Remote ™. The MW (Padulo J and Vando S, Latina, Italy) consisted of an infrared-LED Vishay TSAL 6400 fed with two batteries (CR2032) with a total mass 21 of about 40-gr. It was tightly fixed to the left malleolus of the subjects with an elastic band (Vetrap ™) that allowed a fixed position without impeding the subjects to freely move for walking or running.

The Wii Remote ™ also known colloquially as the Wiimote, is the primary controller for Nintendo's Wii console.

Data Analysis: Kinovea™ 0.8.15 Software for video analysis CoreMeter™ Software (Stefano Vando Latina Italy) for MarkWiiR™ analysis

Statistical Analysis : Bland-Altman test

Conclusion

The present study provided evidence that this device may soon become a valid, reliable, pervasive and low-cost tool providing suitable testing solution for qualitative and quantitative movement kinetics analysis in sport and in clinical settings. Further experiments could be conducted to validate this device for other locomotion/sporting activities.

Pubblicato su Biology of Sport 2015;32:53-58

2013 - Dispositivo per misurare le forze

Reliability of the Wii Balance Board in kayak

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[2]UR CIAMS – Motor Control and Perception Group, Sport Sciences Department, Bât., 335, Université Paris-Sud, 91405 Orsay, France.
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Introduction

Recently the Wii Balance Board (WBB) was showed as good device for assessing postural sway[1, 2]. Moreover, in ecological field[3] there aren't study that have assessed postural sway in kayaker[4]. Besides, during the kayak paddling the power developed by the paddler is shifted to the kayak through the application of forces against a seat [5]. Considering the extensive of this device in sport[6, 7] we believe that Wii balance board can be used also in kayak. For this aim we compare the reliability of the measures of WBB on ground, on WBBm modified as the seat of the kayak on ground and WBBm on kayak in water.

Methods

Eight international male kayakers (age 24.5±2.8 years, body height 1.81±0.1 m, body mass 78±3.6 kg, BMI: 24±0.2 kg•m-2) was performed on WBB (Figure 1) in randomized order in seated position (to emulate kayak place on ground) and in water for to assess postural sway in according to MLTJ guideline[8]. The trials (WBB-WBBm-WBBm on kayak) with Wii balance board was selected for each athlete (Latin square design[9]) for two sets (test- retest) on WBB on ground (Figure 1A) and on WBBm (modified as the seat of the kayak on ground "Seat Sensor"). While other two (test- retest) sessions was performed with a WBBm on kayak (NeloTM 12 kg) in water (Figure 1B). The duration time for each session was 25" with 2 min between sets[10].

References

-1. Clark RA, Bryant AL, Pua Y, McCrory P, Bennell K, Hunt M. Validity and reliability of the Nintendo Wii Balance Board for assessment of standing balance. Gait Posture 2010; 31(3):307-310.
-2. Kalron A, Frid L. Nintendo Wii virtual reality game improves short term balance capabilities in multiple sclerosis patients: a pilot quasi-experimental study. J Phys Ther 2012; 5(2):54-62.
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-8. Padulo J, Oliva F, Frizziero A, Maffulli N. Muscle, Ligaments and Tendons Journal. Basic principles and recommendations in clinical and field science research. Muscles Ligaments Tendons J 2013; 3(4):250-252.
-9. Padulo J, Granatelli G, Ruscello B, D'Ottavio S. The place kick in rugby. J Sports Med Phys Fitness 2013; 53(3):224-231.
-10. Scoppa F, Capra R, Gallamini M, Shiffer R. Clinical stabilometry standardization: basic definitions--acquisition interval--sampling frequency. Gait Posture 2013; 37(2):290-292.
-11. Atkinson G, Nevill AM. Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. Sports Med 1998; 26(4):217-238.
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Figure 1 Wii Balance Board on the ground and in kayak

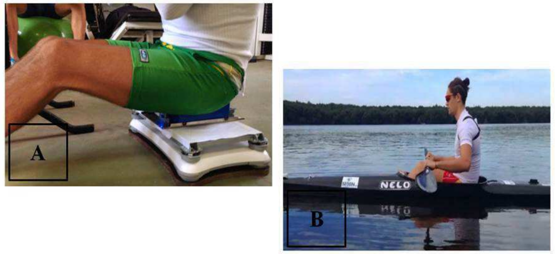
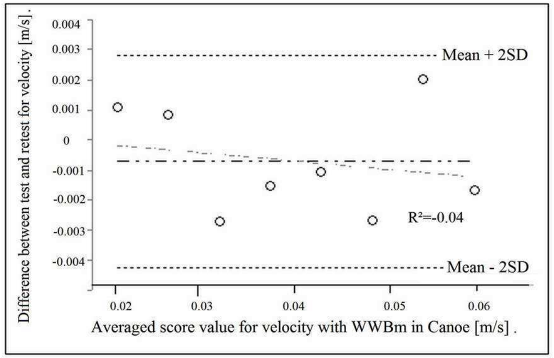


Figure 2 Bland-Altman plotting with limits of agreement between velocity of Centre of pressure between test and retest



Results

Spss 19 was used for the reliability[11] of the measures with Intra-class Correlation Coefficient (ICC) and Bland –Altman tests of the centre of pressure (COP) velocity (mm•s-1). While the three different conditions (WBB-WBBm-WBBm on kayak) was analyzed with an Univariate ANOVA and "Bonferroni" post-hoc analysis. The significant effect was fixed at $p < 0.05$.

ANOVA showed significant effect on the three conditions F=9.121 with $p<0.001$. The path was 19.01±1.35 and 16.64±1.41 mm•s-1 in WBB and WBBm respectively ($p>0.05$), differently in kayak where there is less stability the path velocity was more higher (33.81±14.96 mm•s-1) with p=0.008 vs. WBB (78%), and p=0.002 vs. WBBm (103%). While the ICC was 0.932 – 0.902 – 0.996 with <3% between repeated measures in WBB – WBBm and WBBm in kayak respectively. Bland-Altman shows good agreement (WBB) with a low systematic bias (-0.29 mm•s-1 or -1.49%) and low confidence interval (-1.69 < 95% IC < 1.11) and the variable is homoscedastic (r=0.02). For WWBm, the Bland-Altman (Figure 2) shows good agreement with a low systematic bias (0.46 mm•s-1 or 2.85% for WWBm and -0.72 mm•s-1 or -2.13% for WWBm in kayak respectively) and moderate confidence interval (-1.05 < 95%IC < 1.97 for WWBm and -4.24 < 95% IC < 2.80 for WWBm in kayak respectively) and the variables are homoscedastic (r<0.1).

Discussion

Moreover, this is the first study that assess the reliability of the postural sway in kayak with a new tool low cost "Wii Balance Board".
Considering the accurate methodological approach and the good reliability of the measures, this article can be encourage the young scientific researcher to assess postural sway during the kayak race to improve the balance and the force during the phases of paddle strokes[12].

Accettato su Muscle Legament Tendoms Journal

2014 - Test a velocità crescente da 100 mt

Wii Balance Board as a device for investigating kayak's biomechanics: a pilot study

S. Vando[1], L. P. Ardigò[2], D. Masala[1], L. Falese[1], J. Padulo[3,4]

[1]Department of Human, Social and Health Sciences, University of Cassino and Southern Lazio, Cassino, Italy; [2]Department of Neurological and Movement Sciences, University of Verona, Verona, Italy; [3]University "eCampus" Novedrate, Italy; [4]Tunisian Research Laboratory "Sports Performance Optimization", National Center of Medicine and Science in Sport, Tunis, Tunisia

Introduction

Considering the validated use of the Wii Balance Board (WBB) as an effective device for assessing the postural sway (1), we believe that WBB can be used during kayaking too. This may prompt to a simple way to estimate *2D* velocity and mechanical work at seat (Ws). The power developed by the paddler is transferred to the kayak through the application of forces against foot bar and seat (2). The seat is fixed in the propulsive direction and contributes to the net propulsive force (3).

Methods

One international male kayaker (Age: 35 y, height 1.82 m, weight 76 kg) performed 3×100-m sprints on an Olympic K1 kayak with a WBB (100 Hz) modified (**Figure 1**) as seat at 1.01, 1.18 and 1.54 Hz paddling frequency (freq). Kayak's velocity was clocked. *2D* antero-posterior and medio-lateral COP positions over time were firstly used to calculate its instantaneous velocity (v). Then *v* was put into the mechanical kinetic energy equation: $E_k = ½\, m\, v^2$, with m as subject's mass. By assuming **a**) seat force rigidly transferred to kayak, **b**) most of the weight supported by the seat and **c**) negligible contribute to subject's kinematics due to the reciprocating upper arms' movement during paddling, (positive) ΔE_k resembles athlete's centre of pressure (COP) Ws and – through just a constant displacement offset – his body centre of mass (BCOM) Ws as well.

Figure 1. Kayak's seat

Results

Kayak's velocity increased (+23% with respect to lowest value) linearly (*r*=0.99) over freq (Figure 2A). Due to COP kinematics over increasing freq, COP (and BCOM) Ws increased linearly (*r*=0.96) over kayak's velocity as well (+50 and +100%, respectively; Figure 2B). Such a specific variables' combined change could prompt to develop new efficiency indexes to support different level kayakers to optimize their paddling technique. Such an ecological approach could be useful for Ws analysis in kayak-ergometer too.

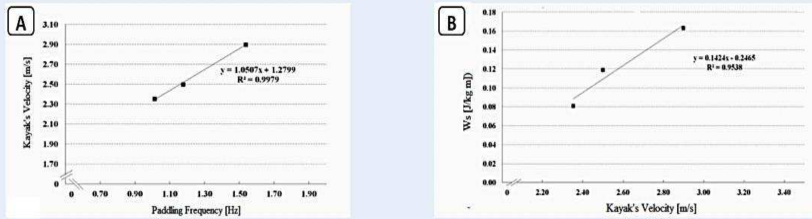


Figure 2. Kayak's velocity over frequency (A) and COP Ws over kayak's velocity (B)

Conclusion

The results of this pilot study are promising. Further athletes of different racing level could be investigated by means of the described methodological approach during both training and race. The study of COP and BCOM biomechanics could reveal to be helpful for both improving performance and reducing injury in kayaking.

References

[1] Clark RA et al. (2010) Validity and reliability of the Nintendo Wii Balance Board for assessment of standing balance. Gait & Posture 31: 307–310
[2] Michael JS et al. (2009) Determinants of kayak paddling performance. Sports Biomechanics 8: 167–179
[3] Shephard RJ. (1987) Science and medicine of canoeing and kayaking. Sports Medicine 4: 19–33

Presentato al Congresso Internazionale Sismes Napoli - 2014

Notizie da PubMed

Dal 1963 al 2015

anni	articoli/anno	articoli/mese
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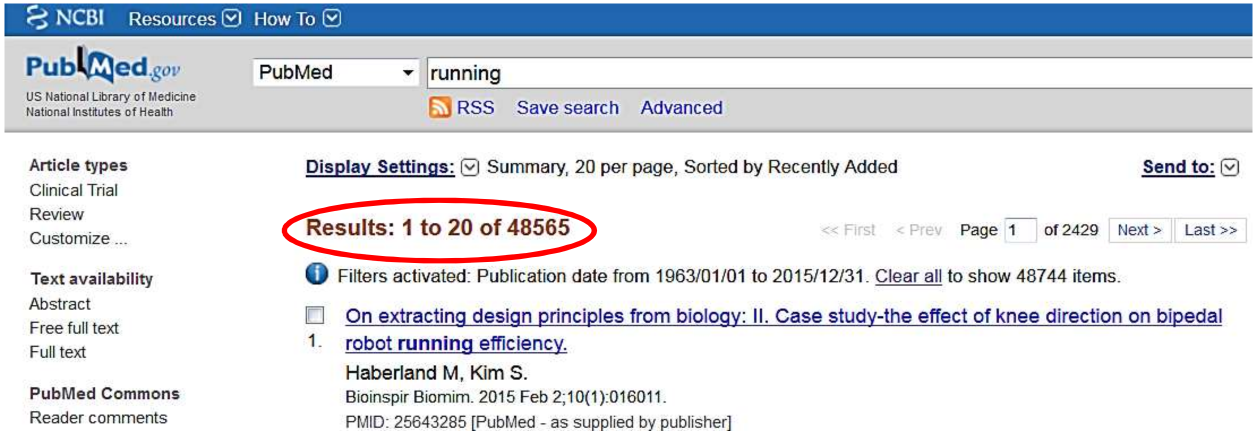


Dal 1963 al 2015

anni	articoli/anno	articoli/mese
52	934	78

Progetto Ferrari Kayak

Anche la FICK può avviare un nuovo cammino verso ricerca e performance…

Kit Ferrari

Controllo a distanza in telemetrico di:

12 Kg

Pagaia

Puntapiedi

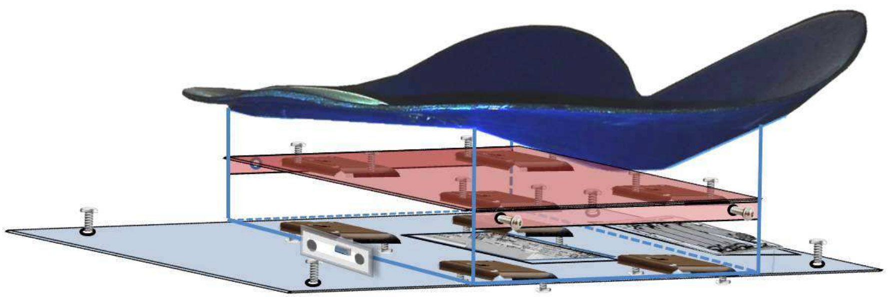
Accelerometro, Giroscopio

Seggiolino

GPS

Seggiolino SeatSensor™

E' un dispositivo stabilometrico dotato di celle di carico posizionate su 4 lati per la misurazione delle forze pelviche e del COP. Al suo interno è stato integrato un accelerometro triassiale per la misura delle accelerazioni angolari del Kayak. Tutto è associato ad un Pad che tramite il software CoreMeter controlla e registra i dati.



Caratteristiche tecniche :

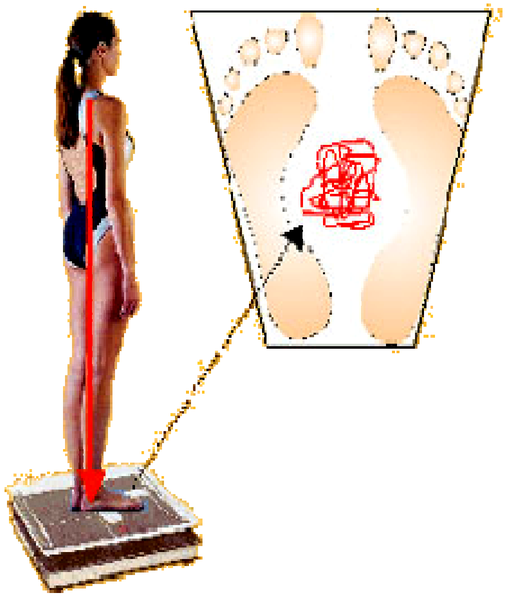
- Frequenza: ~100 Hz
- Trasmissione dati: via Bluetooth 10 mt
- Alimentazione: 6 batterie 1,5 Volt
- Pad: S.O. Windows
- Peso: 3 Kg

- è adattabile al pagaiergometro

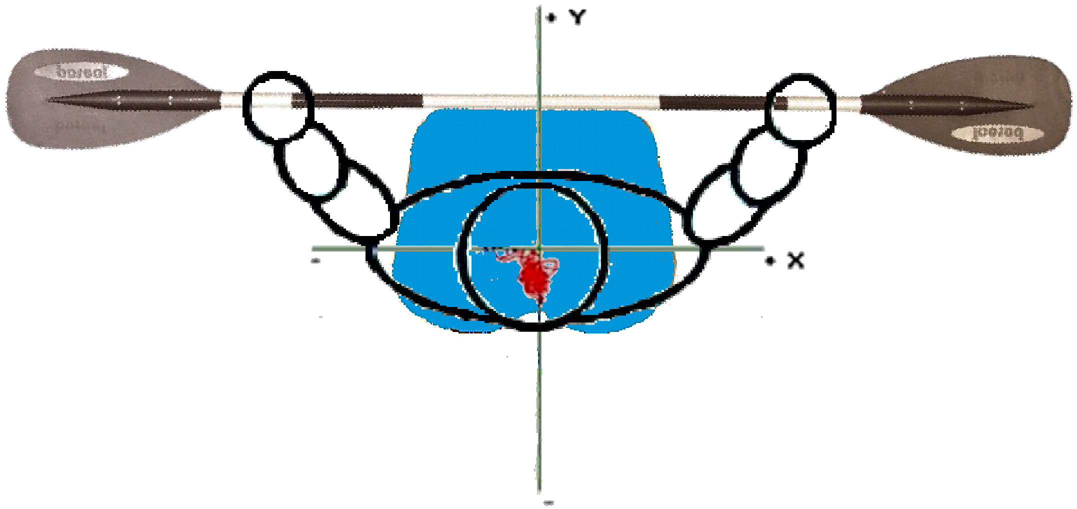
La postura

Viene definita come la «*posizione del corpo nello spazio e la relativa relazione tra i suoi segmenti corporei*». L'analisi posturale in ambito sportivo fornisce dati predittivi sulla capacità di equilibrio e stabilità. Inoltre si rivela importante nella prevenzione degli infortuni causati dalla presenza di asimmetrie.

Centro di pressione COP



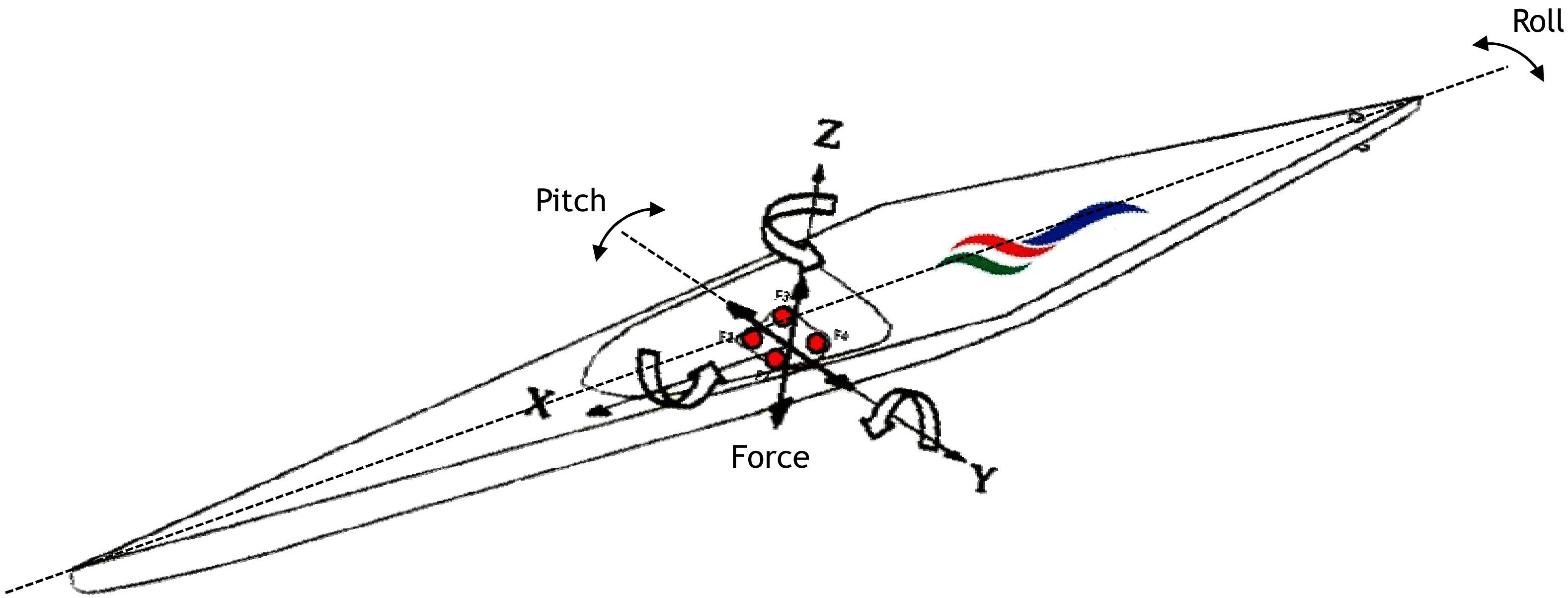
Stazione eretta



Posizione seduta

Influenza posturale sull’andatura del kayak

Questo studio si propone di valutare e oggettivare quanto e come l’assetto posturale del canoista incide sull’andamento del Kayak. Queste variabili si possono ottenere grazie all’impiego di un accelerometro triassiale per rilevare le accelerazioni angolari dell’imbarcazione (X,Y,Z, beccheggio e rollio), in combinazione con il SeatSensor che rileva il COP e le forze pelviche dell’atleta sul seggiolino



Materiali e metodi

Metodi:

- *Soggetti*: 6 canoisti d'elite di sesso maschile (età 25,5 ± 2,1 anni, statura 1,87 ± 0,1 m, massa corporea 85,8 ± 7.3 kg, BMI: 25,5 ± 1,9 kg•m^{-2})
- *Prova*: 1 test submassimale sulla distanza di 200 mt con partenza da fermo

Materiali:

- SeatSensor (100 Hz)
- Accelerometro triassiale (100 Hz)
- Canoa Kayak (k1)
- Palmare a bordo del Kayak con programma CoreMeter
- Telecamera per filmati
- Cronometro
- Software CoreAnalysis per l'elaborazione dei dati

- Luogo: Castel Gandolfo mattina e di pomeriggio dello stesso giorno
- Condizioni meteo: temperatura esterna 15°; acqua 11°e vento 0,2 mt s

Riepilogo dati

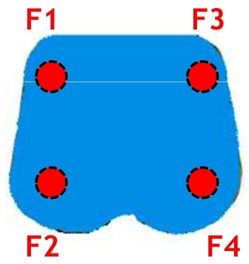
Analisi ed elaborazione dati con programmi Coreanalysis - Excel

Atleta	1	2	3	4	5	6	Media
Tempo (s)	41,07	45,02	42,63	42,63	42,53	42,62	**42,75**
N. colpi	86	86	82	82	79	78	**82**
Frequenza/colpo	126	115	115	115	111	110	**115**
Velocità (m/s)	4,87	4,44	4,69	4,64	4,7	4,7	**4,67**
Cycle length	10,2	8,48	9,02	8,73	8,73	8,6	**8,96**
Cycle Index	49,66	37,67	42,31	40,5	41,06	40,39	**41,93**
2D Wcom (J/kg m)	0,061	0,175	0,092	0,059	0,085	0,063	**0,089**
Path (cm)	615,4	987,4	769,3	690	791,7	669,3	**753,9**
Velocità Media Path (cm/s)	15,58	22,8	18,76	16,65	19,36	16,34	**18,25**
Distanza media COP (cm)	5,3	5,35	6,61	5,98	6,79	5,26	**5,88**
Area (cm^2)	25,17	34,77	23,2	25,33	42,36	50,39	**33,54**
Equilibrio Dx (%)	50	51	52	53	52	50	**51**
Equilibrio Sx (%)	50	49	48	47	48	50	**49**
Equilibrio Ant (%)	19	19	10	13	8	18	**15**
Equilibrio Post (%)	81	81	90	87	92	82	**86**
Sensore ant Sx (Kg)	41	39	16	21	13	40	**28**
Sensore post Sx (Kg)	188	184	166	113	151	103	**151**
Sensore ant Dx (Kg)	48	47	23	17	15	12	**27**
Sensore post Dx (Kg)	181	186	172	136	160	134	**162**
Media tempo/colpi Seat (s)	0,43	0,51	0,54	0,51	0,53	0,55	**0,51**
ACCY Sx+ $(m/s)^2$	5,70	6,69	6,40	8,02	5,58	6,31	**6,45**
ACCY Sx- $(m/s)^2$	-4,43	-4,52	-3,65	-5,54	-2,56	-3,79	**-4,08**
ACCY Dx+ $(m/s)^2$	5,98	9,84	5,84	7,76	6,91	6,49	**7,14**
ACCY Dx- $(m/s)^2$	-2,60	-5,25	-3,95	-5,06	-2,80	-3,78	**-3,91**
Roll Dx (gradi)	3,32	4,01	2,23	5,68	5,92	4,80	**4,23**
Roll Sx (gradi)	-1,69	-1,95	-3,46	-2,64	-2,78	-1,20	**-2,29**
Pitch Su (gradi)	10,40	14,70	11,40	13,00	15,76	12,87	**13,02**
Pitch Giù (gradi)	-5,60	-8,10	-6,90	-7,80	-5,75	-6,82	**-6,83**
Media tempo/colpi Acc (s)	0,44	0,53	0,51	0,52	0,53	0,54	**0,51**

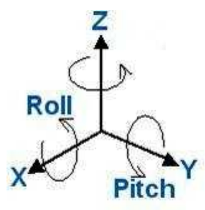
= Colpi*60/tempo

Lunghezza ciclo:(m/cycle)
Indice ciclo:(m^2/(cycles·s)) (1)

Dati SeatSensor



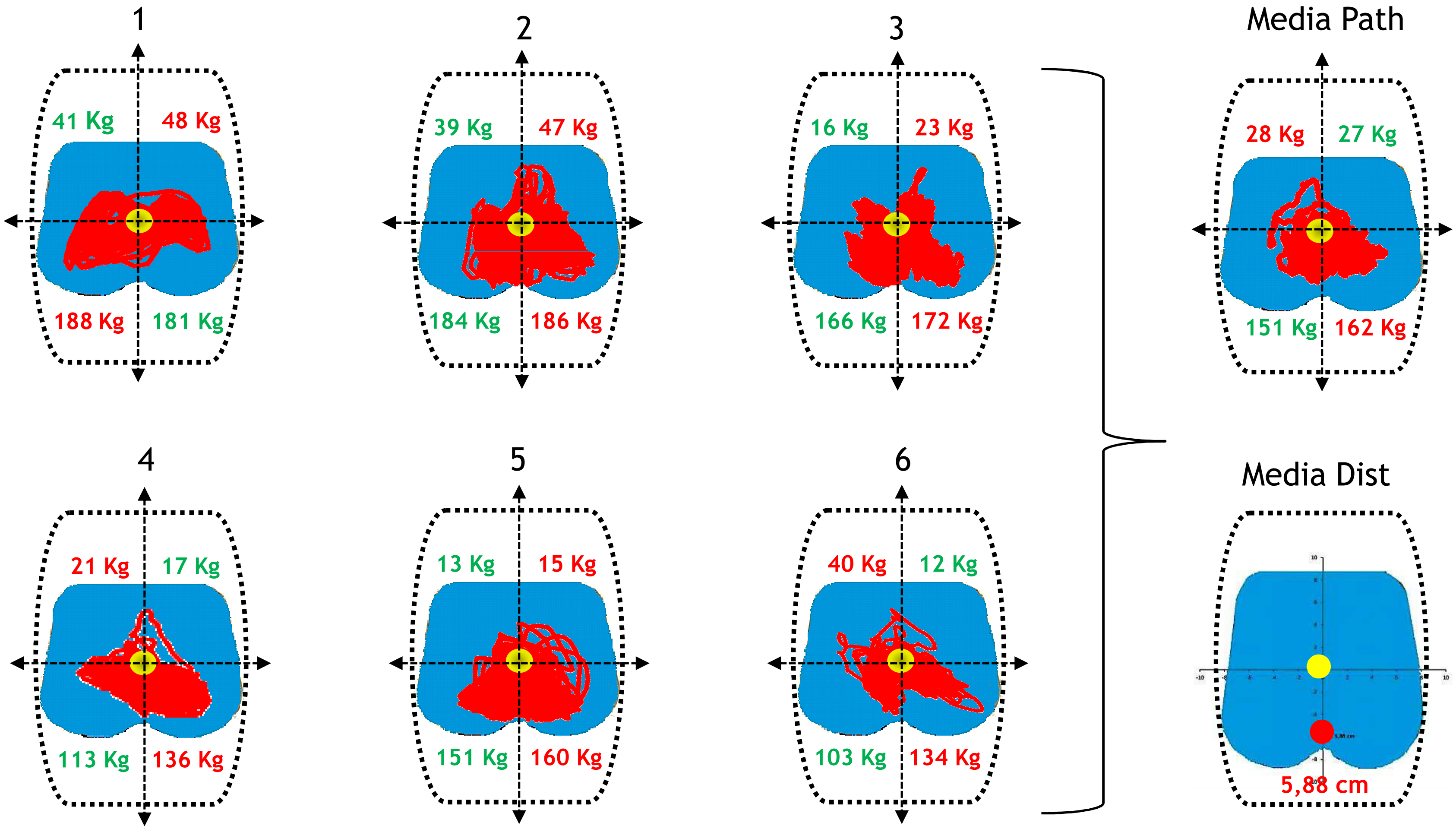
Dati Accelerometro



1. Kinematic Variables Evolution During a 200-m Maximum Test in Young Paddlers - Raquel Vaquero-Cristóbal, Fernando Alacid, Daniel López-Plaza, José María Muyor, Pedro A. López-Miñarro

Risultati Centro di Pressione COP

Atleta	1	2	3	4	5	6	Media
Path (cm)	615,4	987,4	769,3	690	791,7	669,3	**753,9**
Dist. Media (cm)	5,3	5,35	6,61	5,98	6,79	5,26	**5,88**

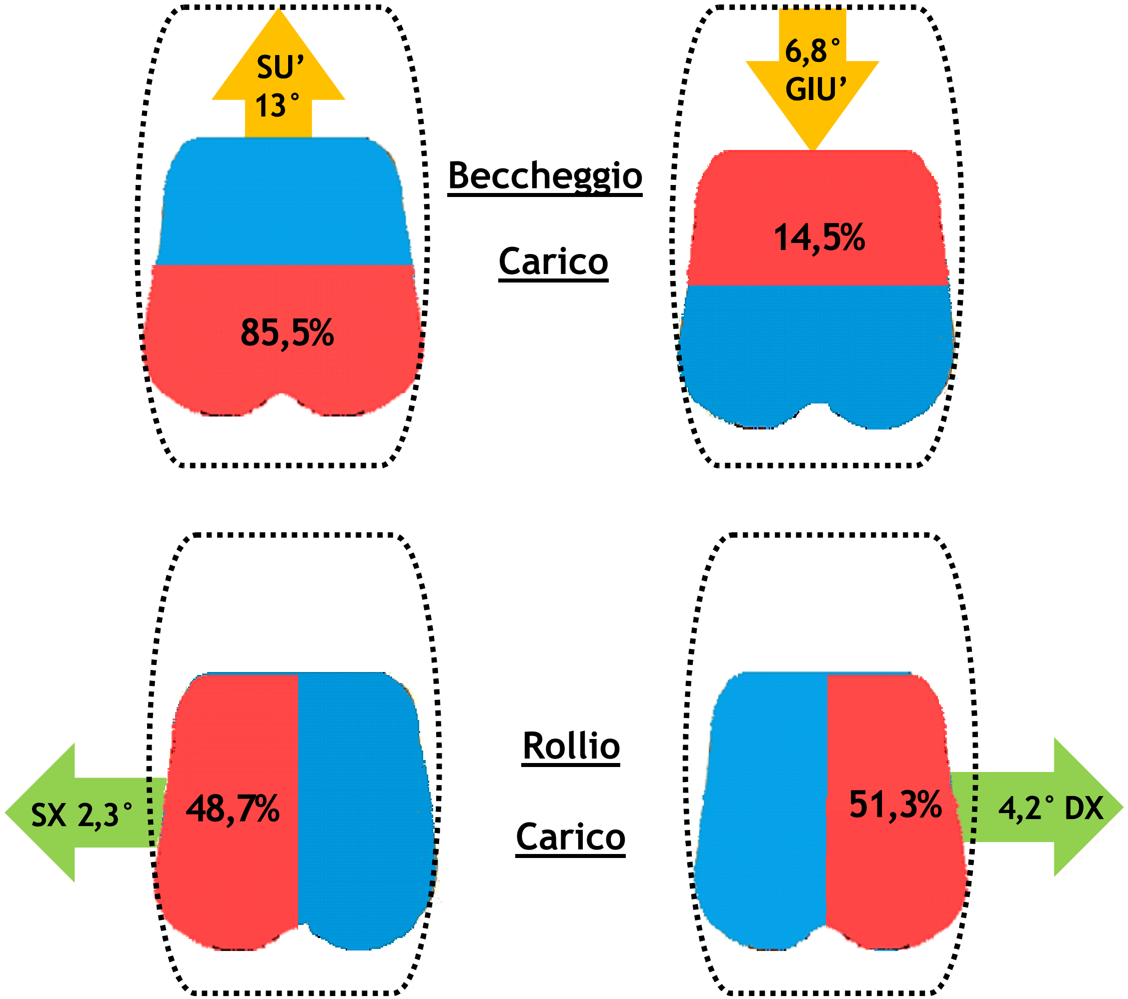


Risultati medi carico e inclinazioni

I dati confermano una relazione coerente tra l'andamento del carico con le inclinazioni

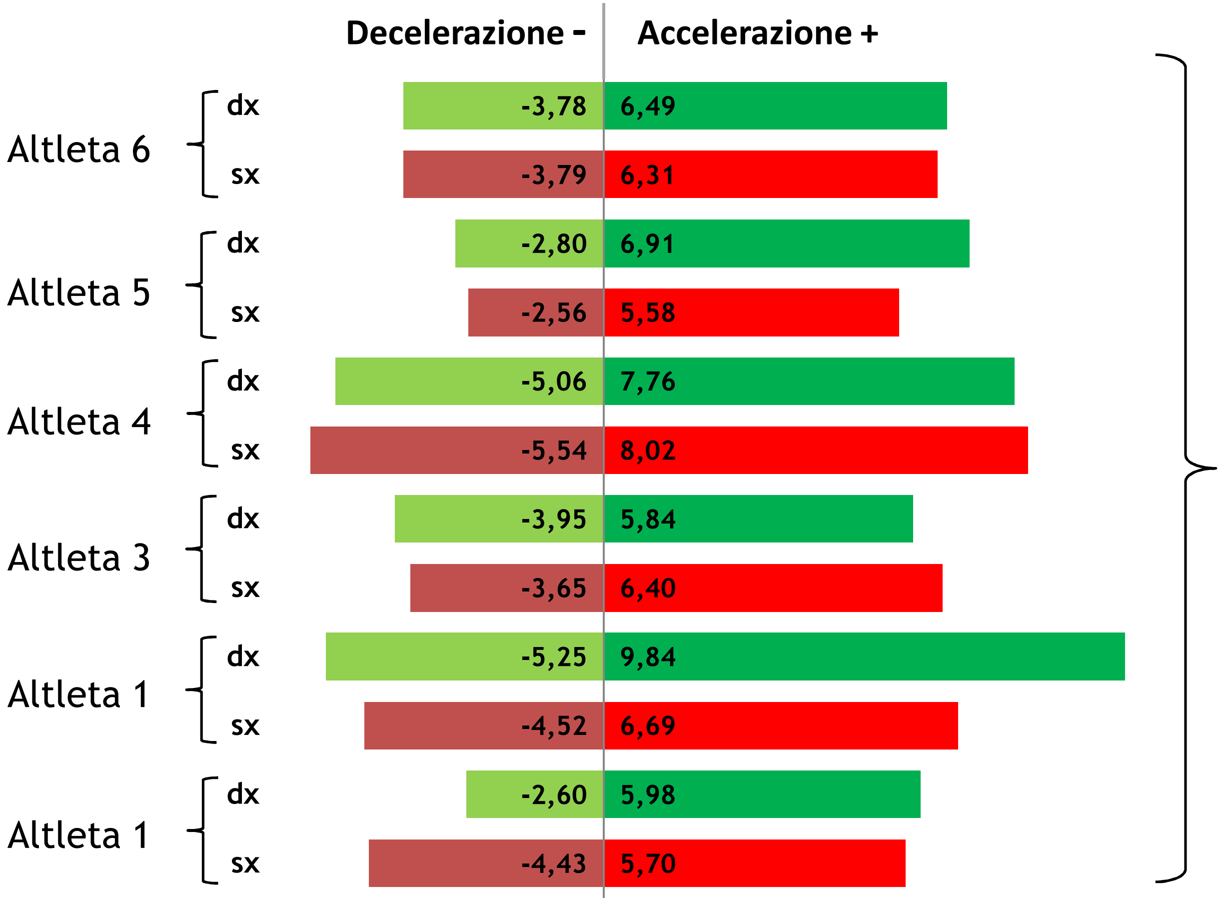
- Carico SeatSensor (%)
- Rollio Accelerometro (°)
- Beccheggio Accelerometro (°)

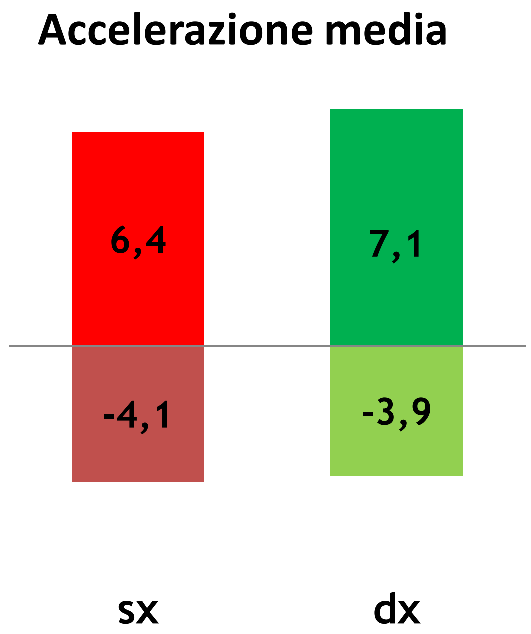
Roll Dx	Roll Sx	Pitch Su	Pitch Giù	Carico Dx	Carico Sx	Carico Ant	Carico Post
3,3	1,7	10,4	5,6	50	50	19	81
4,0	2,0	14,7	8,1	51	49	19	81
2,2	3,5	11,4	6,9	52	48	10	90
5,7	2,6	13,0	7,8	53	47	13	87
5,9	2,8	15,8	5,8	52	48	8	92
4,8	1,2	12,9	6,8	50	50	18	82
4,2	**2,3**	**13,0**	**6,8**	**51**	**49**	**15**	**86**



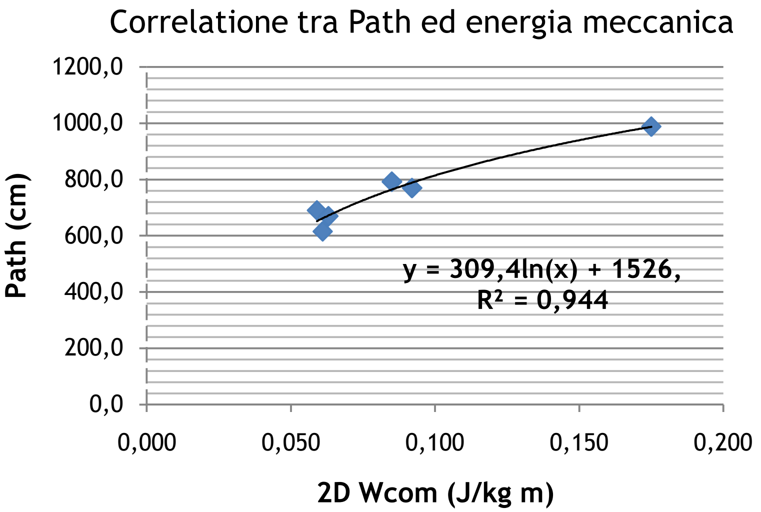
Risultati medi accelerazioni longitudinali

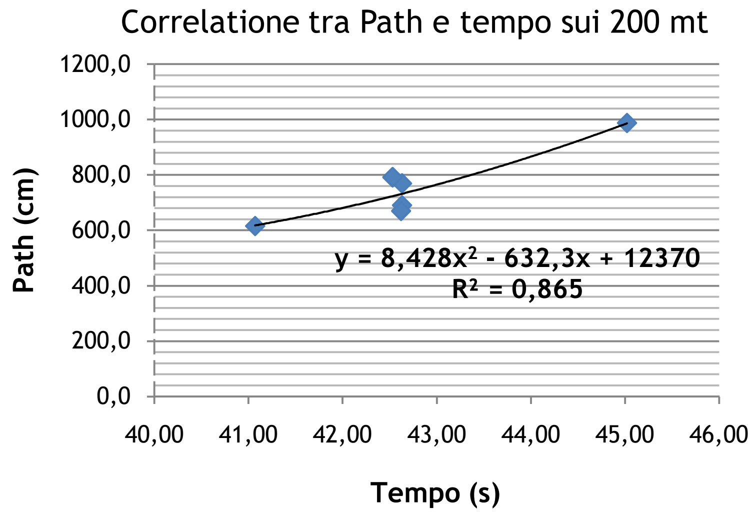
La figura evidenzia le differenze tra le accelerazioni e decelerazioni suddivise tra i cicli Dx e Sx di ogni atleta

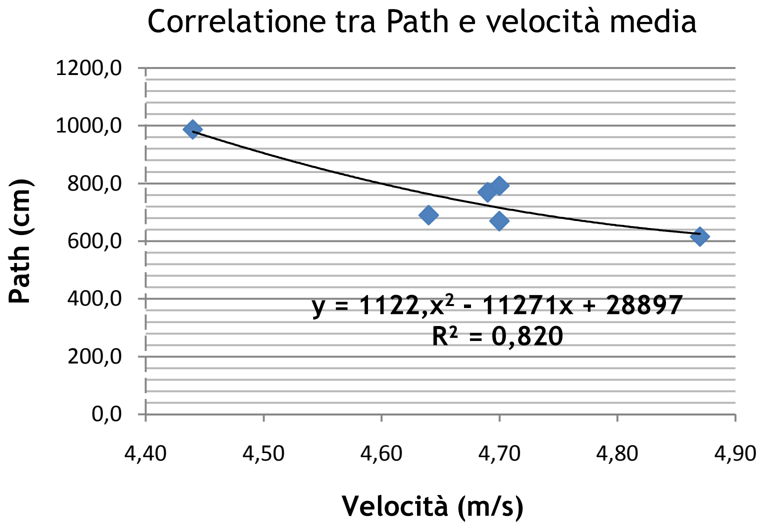


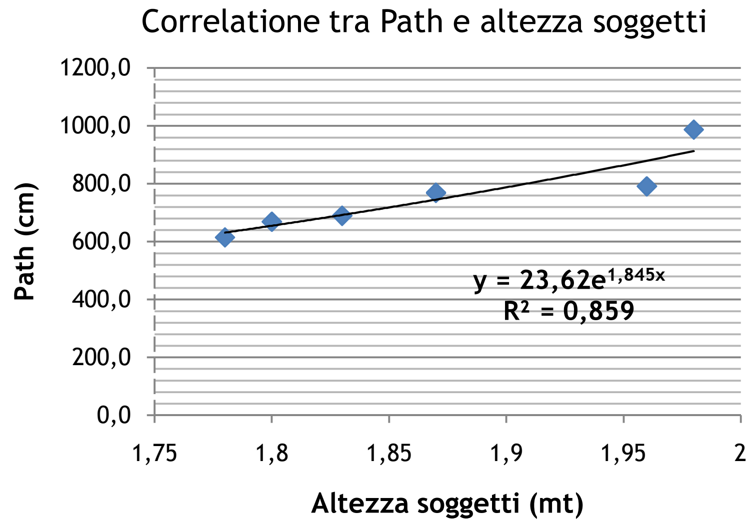


Correlazione tra variabili diverse





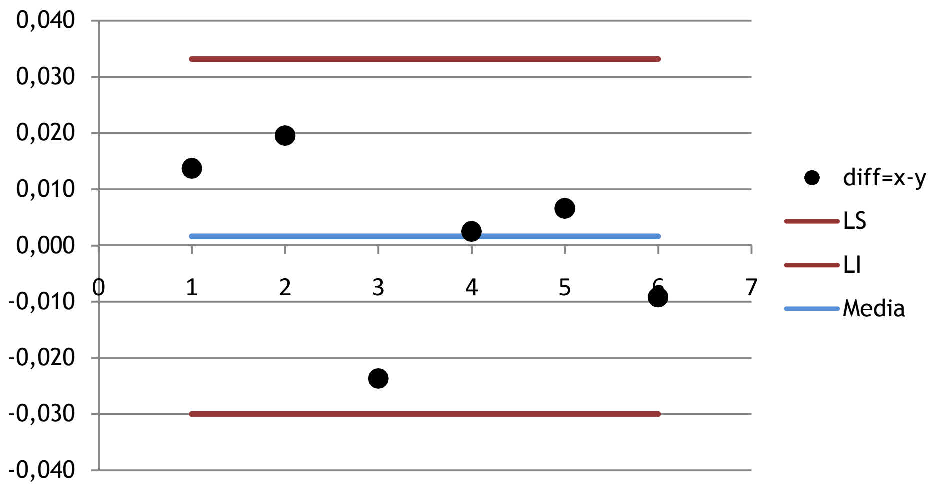




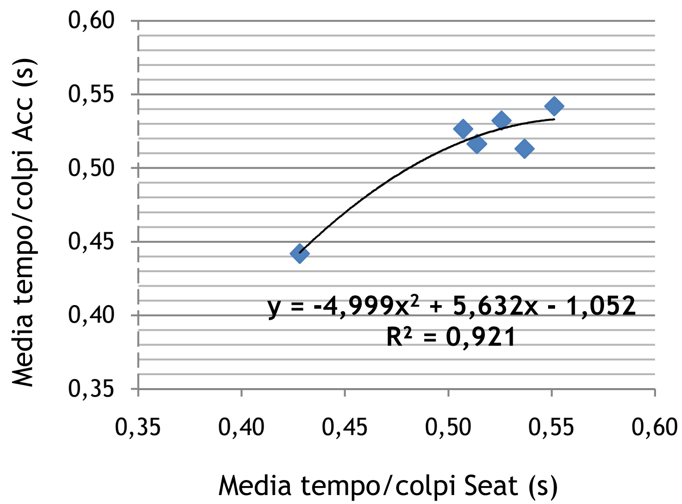
Comparazione misure tra strumenti

Bland Altman test per comparate le misure di tempo/colpo tra accelerometro e SeatSensor

Media tempo/colpi Acc	Media tempo/colpi Seat	mn=0.5*(x+y)	diff=x-y	LS	LI	Media
0,44	0,43	0,435	0,014	0,033	-0,030	0,002
0,53	0,51	0,517	0,020	0,033	-0,030	0,002
0,51	0,54	0,525	-0,024	0,033	-0,030	0,002
0,52	0,51	0,515	0,002	0,033	-0,030	0,002
0,53	0,53	0,529	0,007	0,033	-0,030	0,002
0,54	0,55	0,547	-0,009	0,033	-0,030	0,002



Bland Altman Plot



Correlazione di Pearson

Discussione

In questa prima fase i risultati posturali forniscono informazioni precise su:

- distribuzione delle forze pelviche sul seggiolino;
- comportamento accelerometrico della canoa;

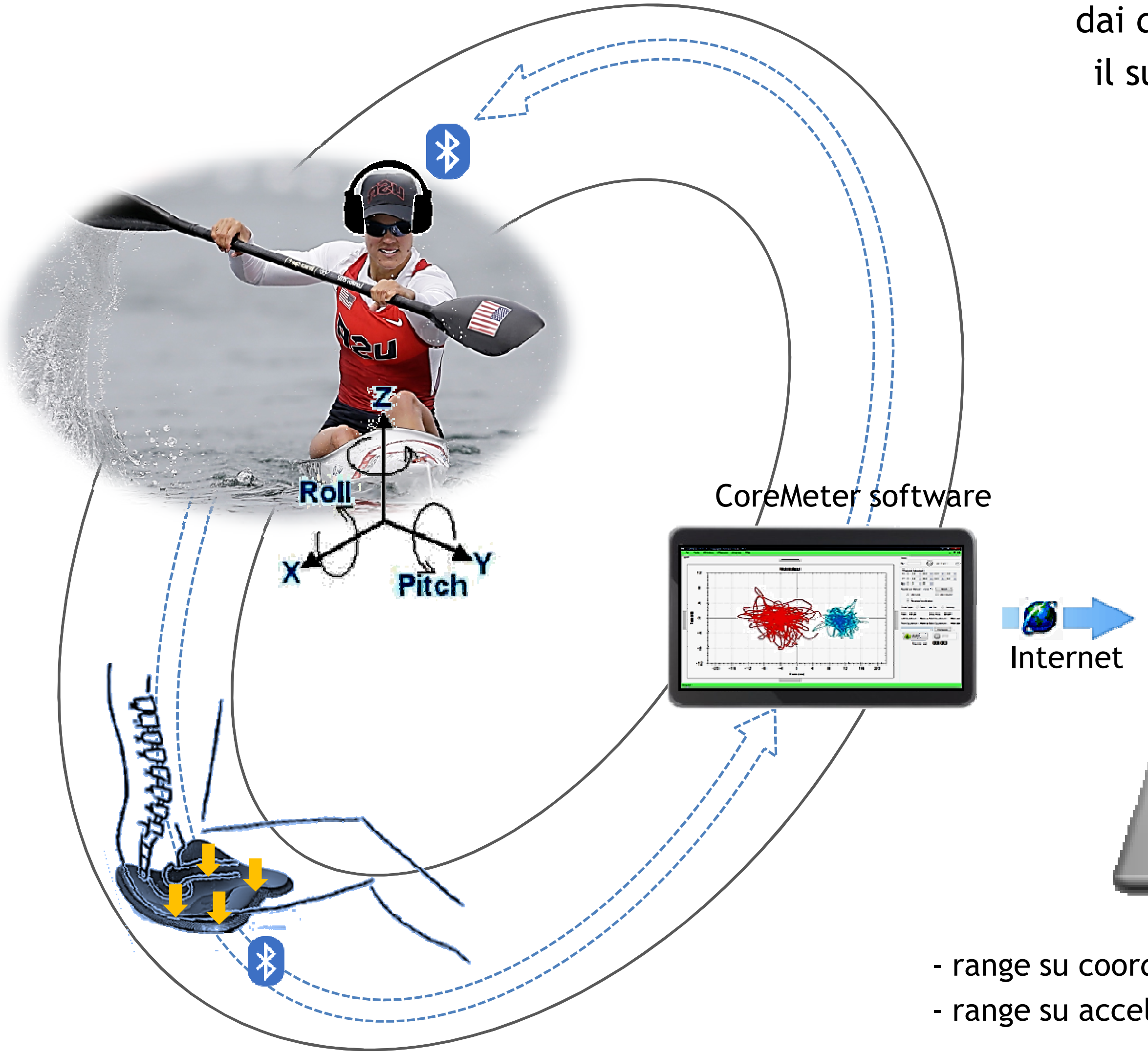
Una studio condiviso di queste variabili può orientare i tecnici e gli atleti a sperimentare piccoli aggiustamenti personalizzati e controllabili nel tempo su:

- strategie d'allenamento;
- modifiche strutturali del Kayak;

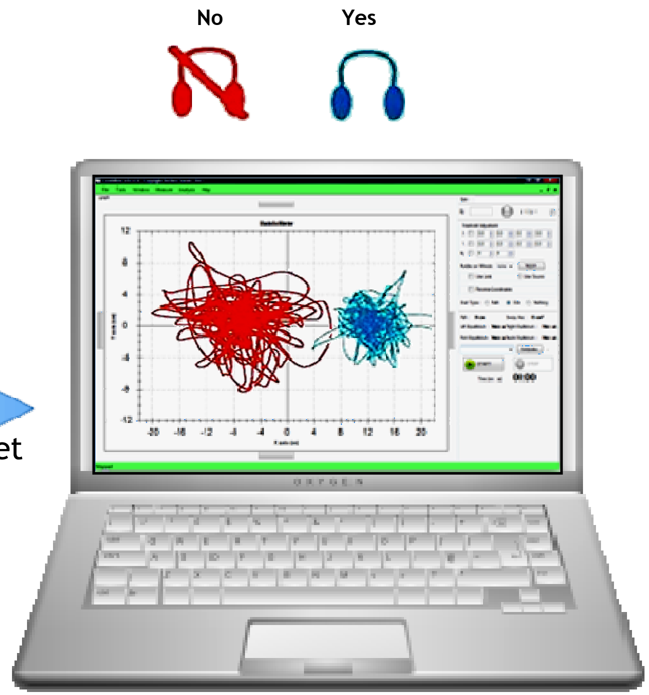
Inoltre queste questa fase è propedeutica a quella successiva ovvero:

- l'impiego dell'audio feedback per guidare l'atleta in tempo reale ad un controllo efficace delle forze pelviche e successivamente testarne gli effetti.

Audio feedback in real-time



L'atleta riceve segnali audio in real-time dai dispositivi associati che segnalano il superamento dei limiti impostati e facilitano le azioni programmate di autocontrollo



- range su coordinate o carico del SeatSensor
- range su accelerazioni o inclinazioni dell'accelerometro

Conclusione

Questo studio accompagnato dall'utilizzo di apparecchiature tecnologiche presenta opportunità applicative volte alla conoscenza del potenziale funzionale dell'atleta e della sua economia esecutiva.

Tutto ciò può trovare interesse da parte di tutte le figure professionali che collaborano per ottimizzare la performance del canoista senza trascurare gli aspetti della prevenzione.

L'obiettivo è costruire un banca dati utile ai tecnici per riconoscere il talento e per studiare in modo oggettivo nuove metodiche d'allenamento.

Tuttavia sono necessari ulteriori studi e approfondimenti per dimensionare le apparecchiature alle necessità e per valutare gli effetti acuti e cronici dei metodi d'allenamento somministrati soprattutto per quelli basati sugli stimoli sensoriali (uditivi, visivi, vibrotattili).

Un sentito ringraziamento a tutti coloro
che hanno sostenuto questa esperienza

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