



vCampus **Live! 2011**

Human Body Performance Monitoring and Modeling Using PI System 2010 and PI Coresight

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Who are we?



- We strongly believe in the fact that every system has an unused potential and the only way to achieve higher level is with data.



Agenda

- Model of performance
- On Ice Testing
- Mobile Lab infrastructure
- Energy expenditure monitoring
- Injury analysis
- Conclusion and questions



Human Performance



Human performance model

- Moment in time
- Context
- Values / Goals
- Oxygen uptake kinetics
- Biomechanics
- Thoughts / Perceptions
- Failure consequences
- Stress Level
- Time Pressure
- Fatigue
- Decision Making



Amount of energy
available

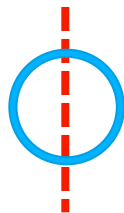
Performance

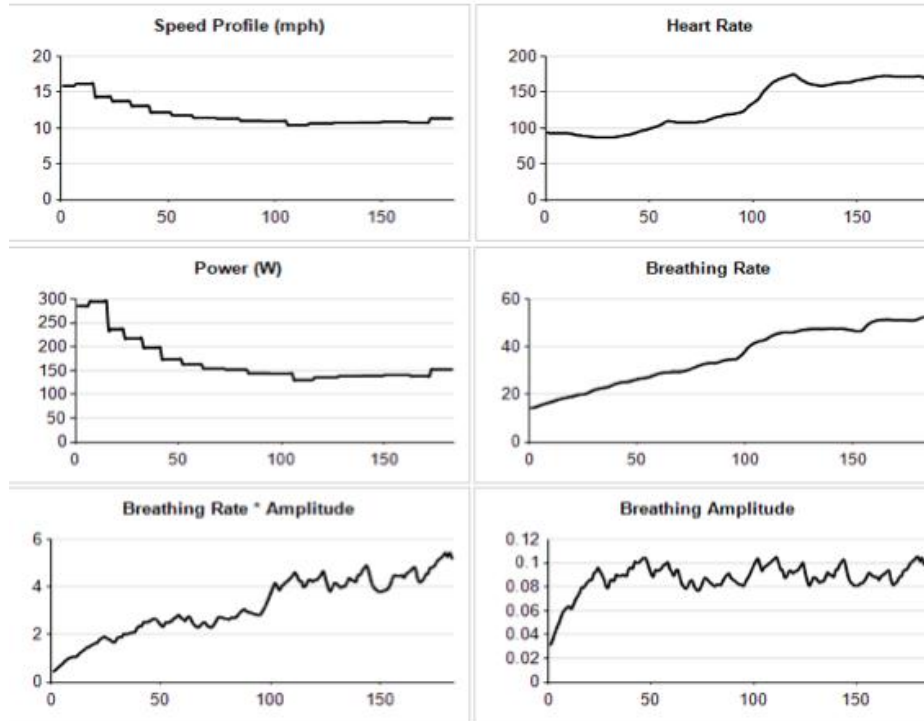




Test Protocol

- 3 minutes all out test
- Chest band monitoring heart rate, breathing patterns, posture, motion and skin temperature
- Logs more than 135 records per second



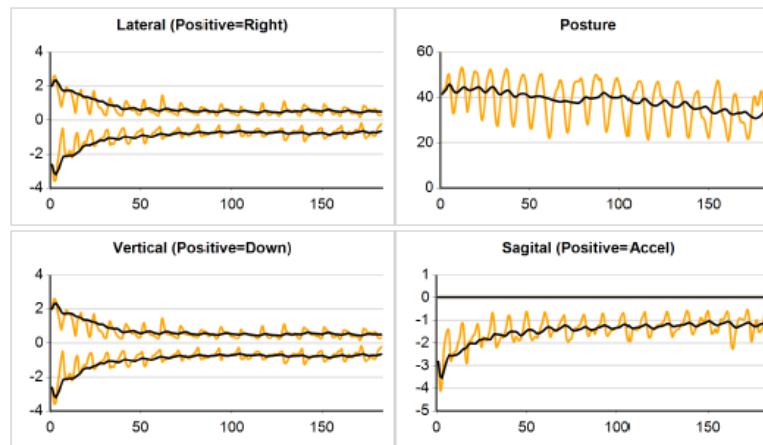


Heart Rate	
Predicted:	195
Maximum:	175
Reserve:	20
Est. VO2max:	51

Power (W)	
Max. Power:	295
Critical Power:	144
Ratio Pmax:	48.7%
Work (KJ):	30.8
WEP (KJ):	7.1

Speed (mph)	
Max:	16.17
Avg.at CP:	10.99

Report Example



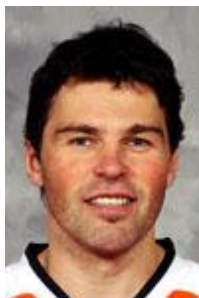
Run	Duration (s)	Speed (mph)	Power (W)	Power Ratio	HeartRate (bpm)	Breathing Rate (bpm)	Left	Right	Posture from Vert.
1	7.64	15.89	286	96.8%	93	14.9	(2.45)	1.84	45.1
2	7.51	16.17	295	100.0%	92	17.0	(1.63)	1.38	43.8
3	8.32	14.61	244	82.7%	89	18.9	(1.22)	1.18	44.1
4	8.78	13.82	220	74.5%	87	20.8	(1.09)	0.85	41.3
5	9.23	13.16	200	68.0%	89	23.2	(1.03)	0.67	41.3
6	9.88	12.29	177	59.9%	95	25.4	(0.95)	0.65	40.1
7	10.26	11.82	164	55.7%	105	27.4	(0.86)	0.59	39.1
8	10.59	11.46	155	52.6%	108	29.3	(0.78)	0.61	36.4
9	10.70	11.34	152	51.6%	111	31.5	(0.72)	0.55	40.7
10	11.00	11.04	145	49.1%	119	33.8	(0.72)	0.53	40.7
11	11.05	10.99	144	48.7%	133	37.5	(0.66)	0.52	38.3
12	11.60	10.47	131	44.5%	163	43.5	(0.75)	0.49	38.0
13	11.40	10.65	136	45.9%	170	46.3	(0.72)	0.47	35.7
14	11.28	10.76	138	46.8%	160	47.4	(0.77)	0.58	36.7
15	11.26	10.78	139	47.0%	164	47.5	(0.79)	0.58	33.1
16	11.17	10.86	141	47.6%	170	48.4	(0.73)	0.52	33.4
17	11.28	10.76	138	46.9%	173	51.3	(0.70)	0.48	31.1
18	10.69	11.36	153	51.7%	172	51.4	(0.72)	0.57	32.6

Report Example



Why PI System 2010?

- 25K records per test
- Need to do automated analysis and reporting
- Asset management where every “element” cost you few MM\$ per year



Hulix - PI System Explorer

File Edit View Go Tools Help

Database Query Date Back Check In New Element New Attribute

Elements

- OnIceTesting
 - DemoReports
 - FlyersTrainingCamp2011-09-15
 - Adam Main
 - Andreas Lilja
 - Andreas Nodi
 - Andrej Mezaros
 - Andrew Rowe
 - Ben Holmstrom
 - Blair Betts
 - Braydon Coburn
 - Claude Giroux
 - Danny Briere
 - Eric Wellwood
 - Erik Gustafsson
 - Ilya Bryzgalov
 - Jakub Voracek
 - James VanRiemsdyk
 - Jason Bacashihua
 - Jody Shelley
 - Johan Backlund
 - Jon Kalinski
 - Kevin Marshall
 - Kimmo Timonen
 - Luke Pither

Adam Main

General Child Elements Attributes Ports Version

Filter

Name	Value
Activity	0.300000011920929
Altitude	Pt Created
AveragePower	Pt Created
AveragePowerLeft	Pt Created
AveragePowerRight	Pt Created
AverageSpeed	Pt Created
Battery	4.09200000762939 V
BH_Number	1
BirthDate	2/15/1979 12:00:00 AM
BreathingAmplitude	0.097000002861023 V
BreathingRate	29.7999992370606 rate per minute
BreathingRate_GPS	Pt Created
BreathingRateRtoR	0.316 rate per minute
DateEnd	9/15/2011 9:45:31 AM
DateStart	9/15/2011 9:42:31 AM
Duration	Pt Created
ECG	2052 mV
ECGAmplitude	7.89999976404942E-05
ECGNoise	3.00000000000000E-06
HeartRate	109 rate per minute

46 Attributes

Elements
Event Frames
Library
Unit of Measure
MyPI
Notifications
Contacts

AF Structure Example

Mobile Lab

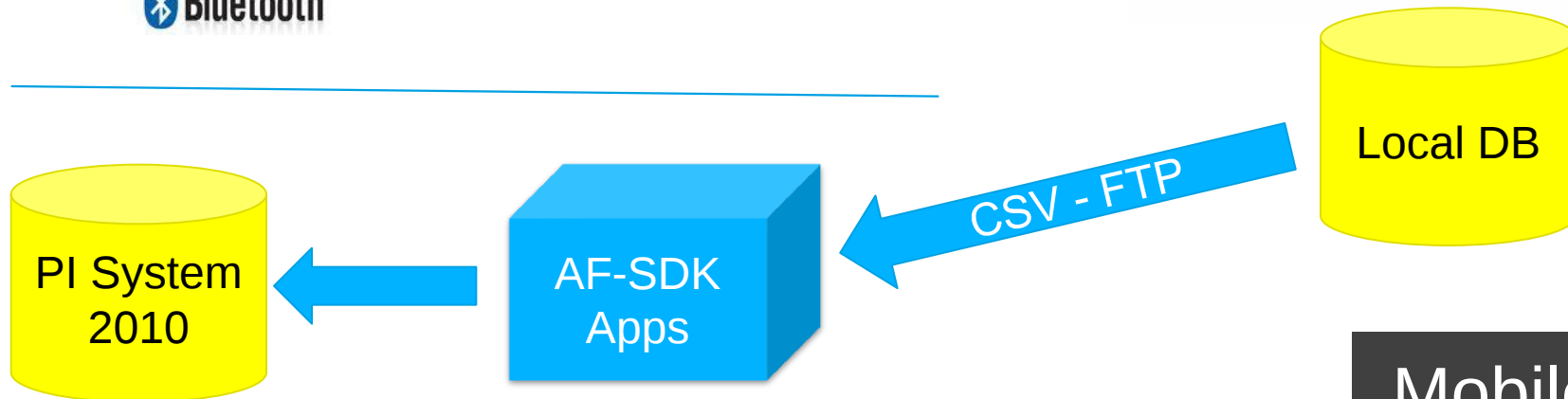




Old Way



New Way

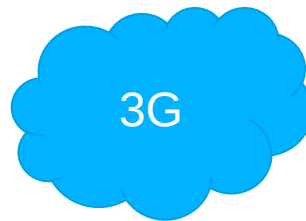


Mobile Lab

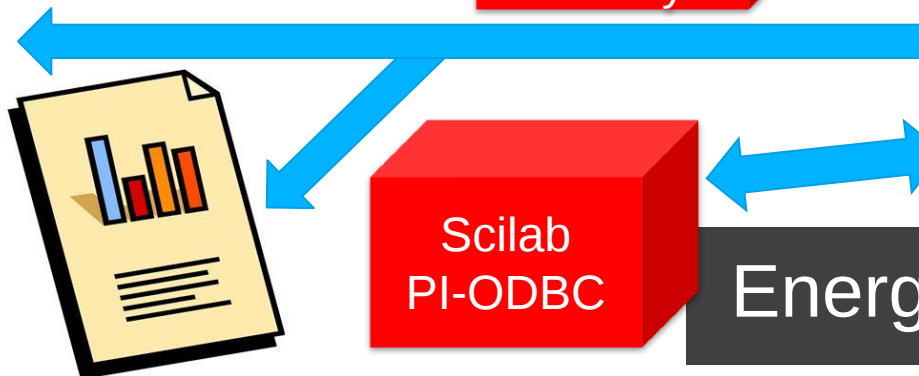
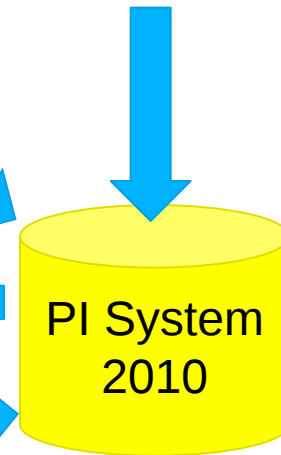
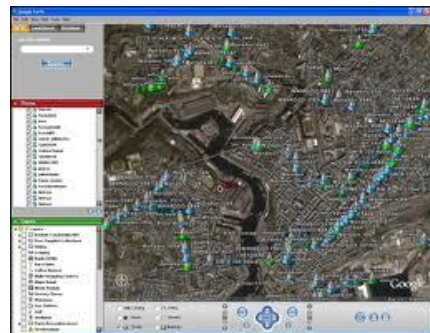
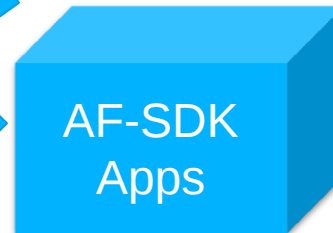
Energy Expenditure, Canadian Forces



- In the field, real-time energy expenditure monitoring
- Musculoskeletal injuries
- 35MM records per day

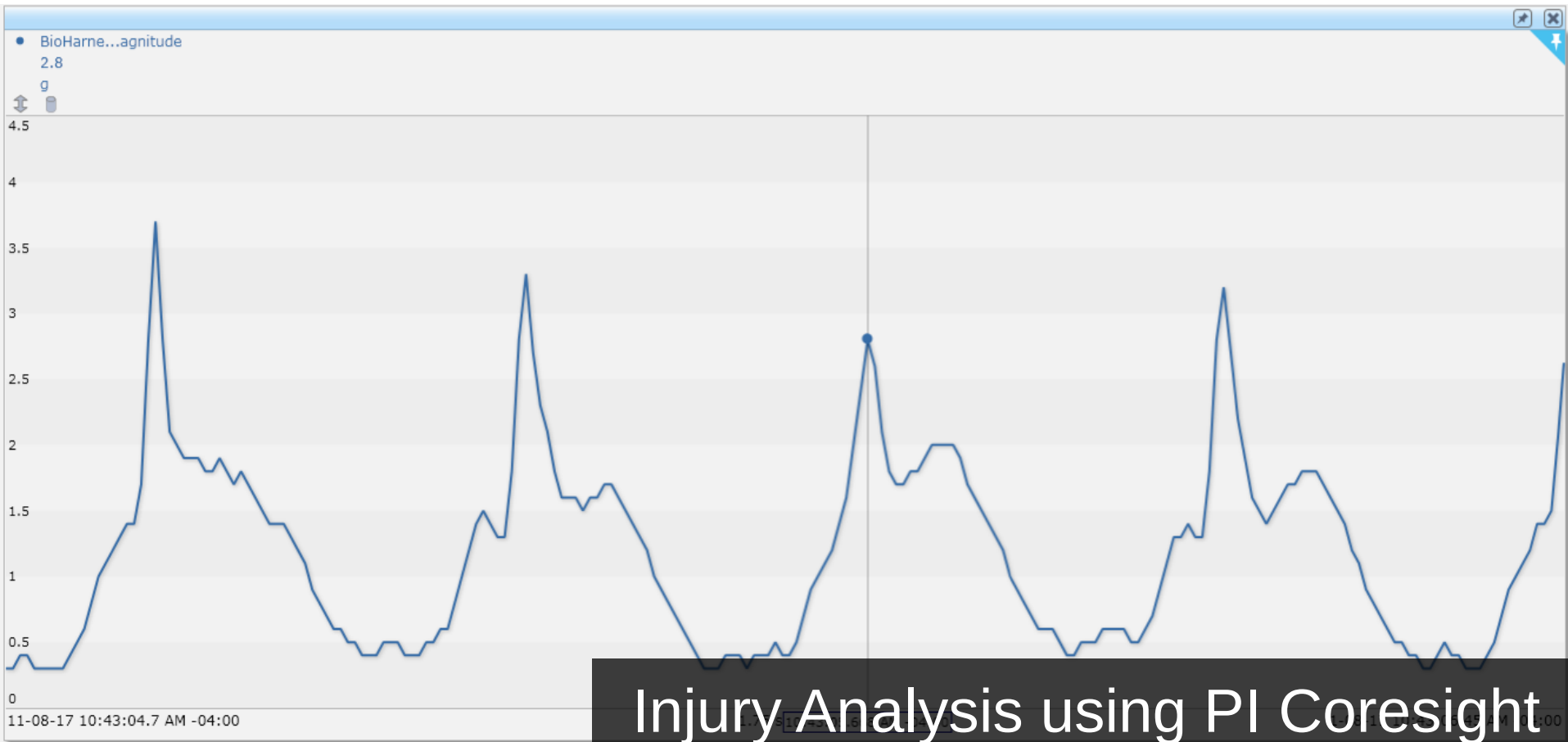


CSV Log File



Energy Expenditure





PI Coresight Added Value

- Easy navigation and data manipulation (Even a Doctor can do it...)
- Save special events in the cart
- Easy deployment on client side



Future improvements

- Incorporation of PI Event Frame to make data analysis more efficient
- Better PI Web Services interaction with mobile device
- Testing new devices every month...



Conclusion

- Large amount of data to deal with
- Data access is a key feature
- Visualization act as jet fuel in building algorithms
- Future projects with Marine Corps, Olympic Athletes, Workers, Canadian Forces, NHL Players



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Thank you

