

Mittwoch, 16. November 2016, 16:15 – 16:45  
GIS Day Switzerland, HSR Hochschule für Technik, Rapperswil

# Sports Technology: Football Player Tracking

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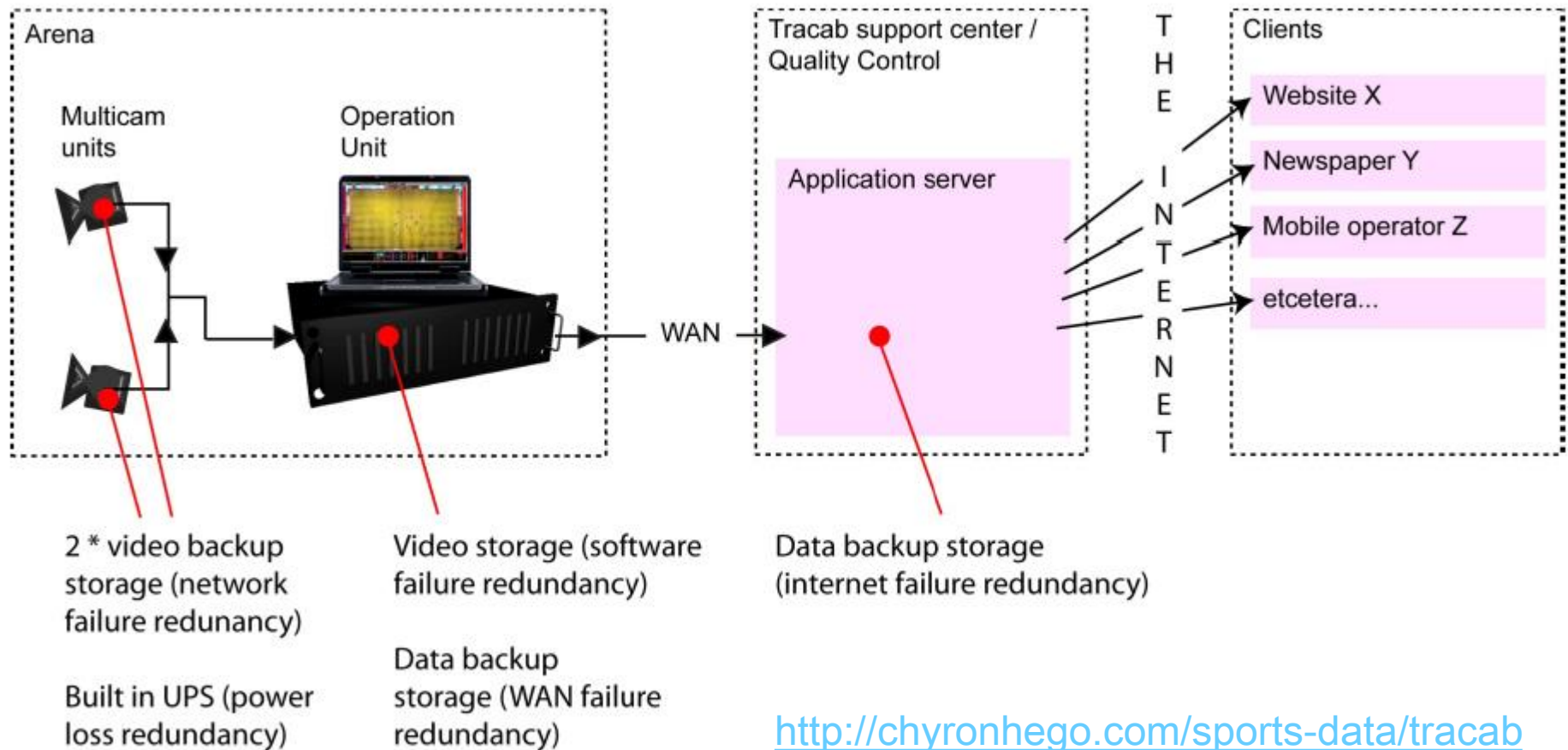
# Sports Technology



<https://www.youtube.com/watch?v=dqDZftgB2lw>

2m25s

# TRACAB Image Tracking System (2003)



# STATS SportVU System Setup (2016)

[www.stats.com/sportvu-football](http://www.stats.com/sportvu-football)





# Hull City total distance covered, October 28, 2016

|                         |  |  |  |  |  |  |  |  |  | TOTAL  | AVERAGE |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------|---------|
| <b>Sam Clucas</b>       | 11.27                                                                             | 11.22                                                                             | 11.71                                                                             | 10.62                                                                             | 11.75                                                                             | 11.31                                                                              | 10.38                                                                               | 11.13                                                                               | 10.79                                                                               | 100.18 | 11.13   |
| <b>Robert Snodgrass</b> | 11.36                                                                             | 11.47                                                                             | 5.7                                                                               | 11.34                                                                             | 11.22                                                                             | 11.25                                                                              | 11.32                                                                               | 11.28                                                                               | 10.54                                                                               | 95.48  | 10.61   |
| <b>Jake Livermore</b>   | 9.55                                                                              | 9.73                                                                              | 9.37                                                                              | 9.74                                                                              | 4.34                                                                              | 9.54                                                                               | 10.08                                                                               | 11.56                                                                               | 11.59                                                                               | 85.5   | 9.50    |
| <b>Curtis Davies</b>    | 9.24                                                                              | 9.26                                                                              | 8.86                                                                              | 9.66                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |        |         |
| <b>David Meyler</b>     | 11.1                                                                              | 11.28                                                                             | 11.41                                                                             | 9.37                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |        |         |
| <b>Andrew Robertson</b> | 8.96                                                                              | 9.34                                                                              | 9.42                                                                              | 9.71                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |        |         |
| <b>Tom Huddlestone</b>  | 10.85                                                                             | 11.71                                                                             | 10.73                                                                             | 10.94                                                                             |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |        |         |

**Ahmed Elmohammedi**  
**Adama Diomandé**  
**Abel Hernández**  
**Ryan Mason**  
**Harry Maguire**  
**Will Keane**  
**Shaun Maloney**  
**Markus Henriksen**  
**Dieumerci Nkomo**  
**Michael Dawson**

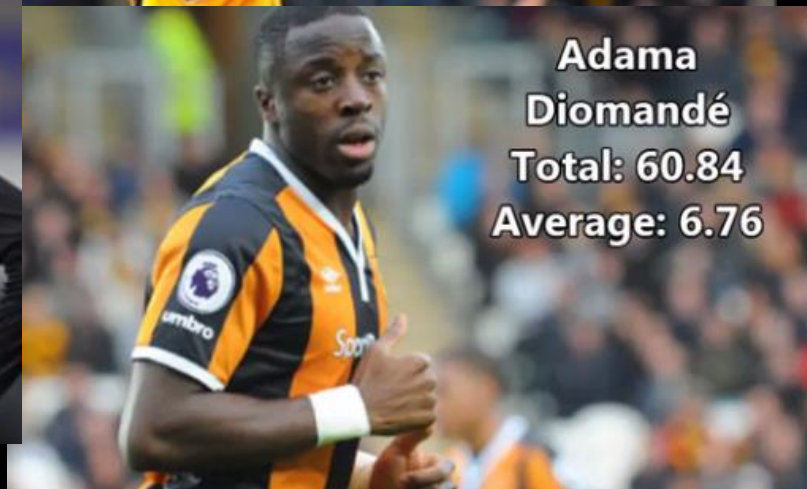
**Sam Clucas**  
**Total: 100.18**  
**Average: 11.13**



**Michael Dawson**  
**Total: 9.47**  
**Average: 9.47**



**Adama Diomandé**  
**Total: 60.84**  
**Average: 6.76**



# Sentioscope: The Soccer Player Tracking Technology [www.sentiosports.com](http://www.sentiosports.com)



| Fenerbahçe           |    |                     |   | Beşiktaş             |    |                     |    |
|----------------------|----|---------------------|---|----------------------|----|---------------------|----|
| Covered Distance (m) |    | Sprint Distance (m) |   | Covered Distance (m) |    | Sprint Distance (m) |    |
| #29                  | 32 | #7                  | 2 | #10                  | 53 | #10                 | 27 |
| #5                   | 31 | #11                 | 1 | #8                   | 49 | #8                  | 20 |
| #11                  | 29 | #29                 | 1 | #9                   | 35 | #9                  | 4  |
| #24                  | 27 |                     |   | #15                  | 33 | #31                 | 2  |
| #77                  | 27 |                     |   | #33                  | 31 | #33                 | 1  |



[www.youtube.com/watch?v=ZVjZh95Ha\\_A](http://www.youtube.com/watch?v=ZVjZh95Ha_A) 1m30s

# Agenda

1. Entwicklung GPS Tracking
2. Fussballspieler Tracking mit GPS
3. Motion Tracking im Sport (Status & Ausblick)

# **1. Entwicklung GPS Tracking**



# GPS Tracking Daten im Internet

**1997 Heissluftballon live im Internet**

2003 Radrennfahrer Tour de Suisse

2005 Wien Marathon, Ski Langläufer

**2008 Fussballspieler Tracking**

2010 Tests mit 2. Liga Interregional, Junioren, ... Mannschaften

**2011 Präsentationen bei Galatasaray und Fenerbahce Istanbul**

2013 Einsatz bei Turnieren in Deutschland

2014 Trainingsunterstützung, Videointegration

**2015 Erweiterte Analysen, Zusammenarbeit mit FieldWiz**

# 1997 Heissluftballon Live im Internet



## Balloon Live

Join us for a scenic [live](#) balloon ride, together with the [Peterka Balloon Team](#):

In our opening contest we have promised three balloon rides. The winners are:



- Gabriel Meier, Chur
- Othmar Truniger, Uster
- Ruben Israel, Collonge Bellerive



The rides will be transmitted in the internet. You can watch [live](#) pictures from the air over our [LiveCam System](#). With our [GPS\\* LiveCam](#) java applet you can see the position of the balloon on a map.

You may have a look at our past rides. You find the pictures in our [archive](#). Please drop an [E-Mail](#), if you wish to be personally informed on upcoming Live Attractions on our SunSITE.

[ [Live](#) | [Live with GPS\\*](#) | [Archive](#) | [SwissCams](#) | [SpecialCams](#) ]

\* GPS: Global Positioning System



Garmin GPS II Plus



# 2002 TourLive Rennsimulator Züri Metzgete

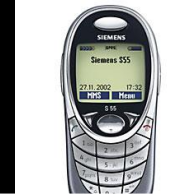


## Tablet PC

- GPSapp (Anwendung)
- USB Kamera Treiber
- RS232-GPS Verbindung
- Bluetooth-Mobile Verbindung
- DFÜ mit GPRS Verbindung



Mobile  
Siemens S55



GPS Empfänger

Garmin eTrex Vista



USB-  
Kabel

Kamera

Philips



# 2009 TourLive Fahrergruppen Tracking (TdS 2003-2016)



**cnlab ag**



NZZ Online



TOUR DE SUISSE



swisscom

**Tour de Suisse Etappe 1 (10.6.06, Baden - Baden)**  
[Rennsituation](#), [virtuelle Rangliste](#)

**Streckenprofil:**



**Fahrinformationen: Webcam:**

Datum: 14.07.2006  
 Zeit: 12:04:09

**Commissaire 1:**  
 v: -km/h  
 h: -m s: -%  
 p: - / -

**RadioTour:**  
 v: -km/h  
 h: -m s: -%  
 p: - / -  
 a: -kn (---:--)

**Commissaire 2:**  
 v: -km/h  
 h: -m s: -%  
 p: - / -  
 a: -kn (---:--)

v: Geschw. s: Steigung  
 h: Höhe p: Position  
 a: Abstand zur Spitze

**Standort:**



**Situation am 17.06.2006 16:50:43 Uhr**

**Spitze (1 Fahrer)**  
 71 CONTADOR VELASCO Alb (LSW)

**1. Gruppe (1 Fahrer)**  
 Rückstand: 00:36 (00:16)  
 91 EVANS Cadel (DVL) [10]

**2. Gruppe (23 Fahrer)**  
 Rückstand: 00:55 (00:33)

3 FLORES GALARZA Iker (EUS) [45]  
 4 HERRERO LLORENTE Dav (EUS) [43]  
 12 SCHLECK Andy (CSC) [45]  
 17 SCHLECK Frank (CSC) [6]  
 18 VANDELVEDE Christian (CSC) [43]  
 21 MOOS Alexandre (PHO) [43]  
 31 ULLRICH Jan (TMO) [1]  
 33 GERDEMANN Linus (TMO) [7]  
 35 KIRCHEN Kim (TMO) [12]  
 42 FERTONANI Marco (CEI) [32]  
 45 KARPETS Vladimir (CEI) [9]  
 62 BOOGERD Michael (RAB) [15]  
 72 CARUSO Giampaolo (LSW) [8]  
 75 JAKSCHE Jorg (LSW) [3]  
 78 VICIOSO ARCOS Angel (LSW) [4]  
 84 BRAJKOVIC Janez (DSC) [5]  
 108 VERHEYEN Geert (QSI) [29]



Fortuna ClipOn GPS  
+ Nokia 6680



# 2015 TourLive Fahrergruppen Tracking, Rennorganisation, Zuschauerinformation

TourLive  
Aufnahmesystem



GPS Tracker



## **2. Fussballspieler Tracking mit GPS**

# SRF Einstein 5.5.2011



<http://www.srf.ch/play/tv/einstein/video/fussball/spielen-mit-gps-navigation?id=8bbe326a-7c94-4760-b8c9-887f6856603a>

## Qstarz MTK II chipset GPS-Logger

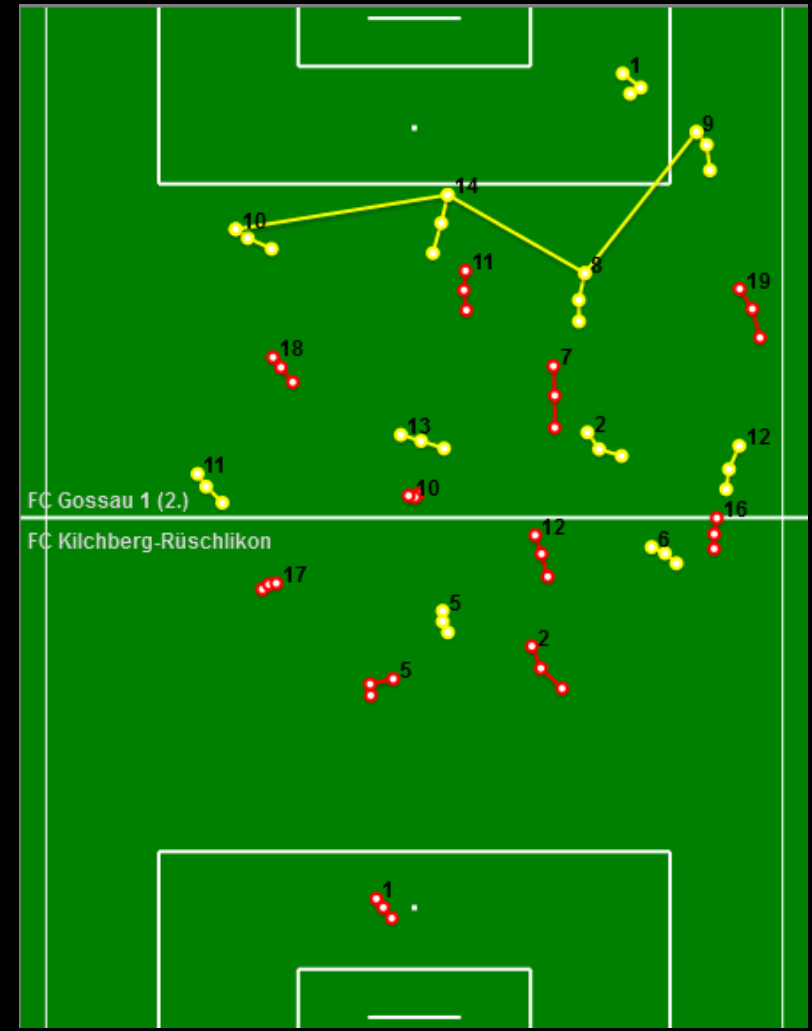
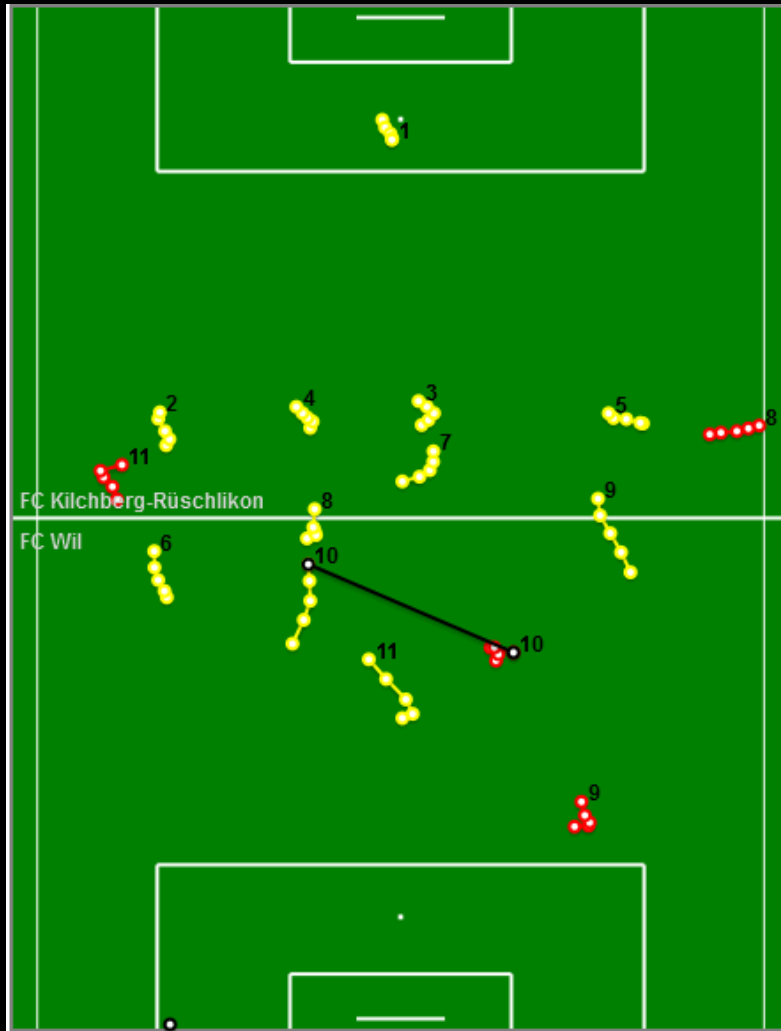
- high sensitivity -165dBm
- 66-Channel tracking
- 4MB Speicher
- DGPS (WAAS + EGNOS + MSAS)
- 5Hz Smpling



|                       |                  |
|-----------------------|------------------|
| Positionsgenauigkeit  | 0.5m             |
| Maximale Aufnahmerate | 5 Hz             |
| Sensor Grösse         | <b>62x38x7mm</b> |
| Sensor Gewicht        | <b>22g</b>       |
| Sensor Betriebsdauer  | 3 h              |

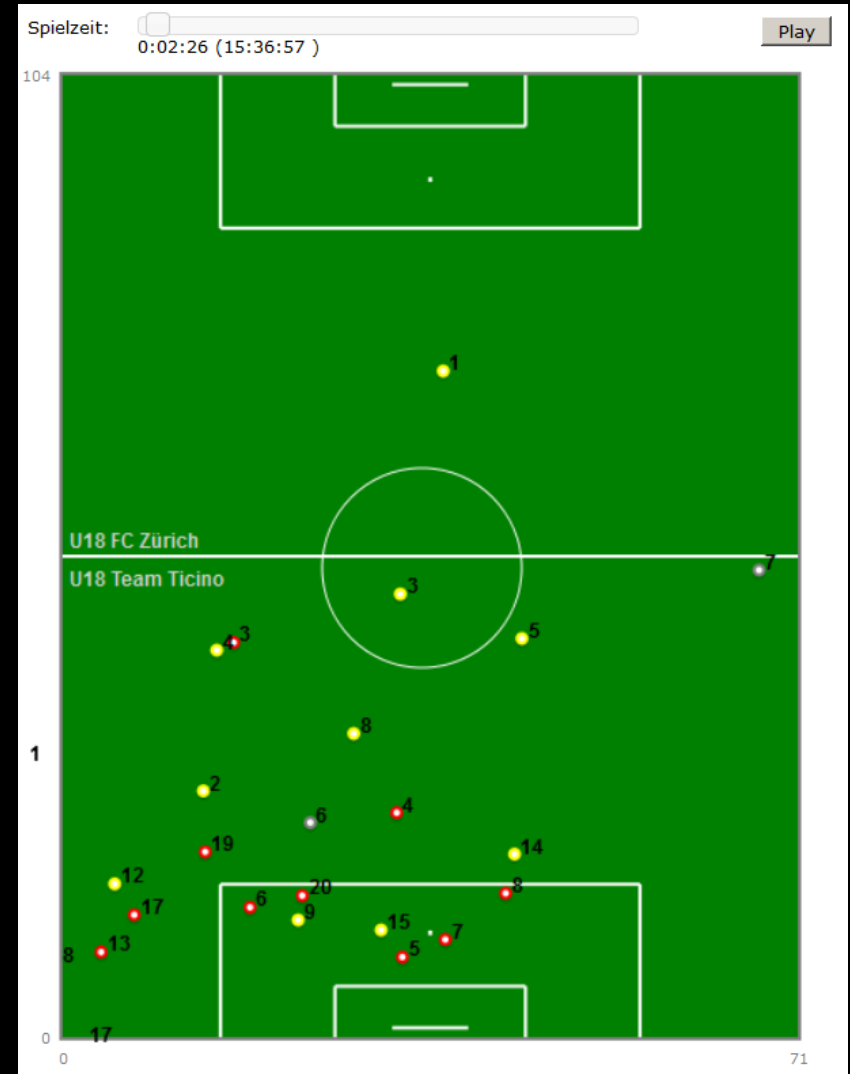
# Auswertung Taktik

# Replay der Positionen mit taktischen Auswertehilfen

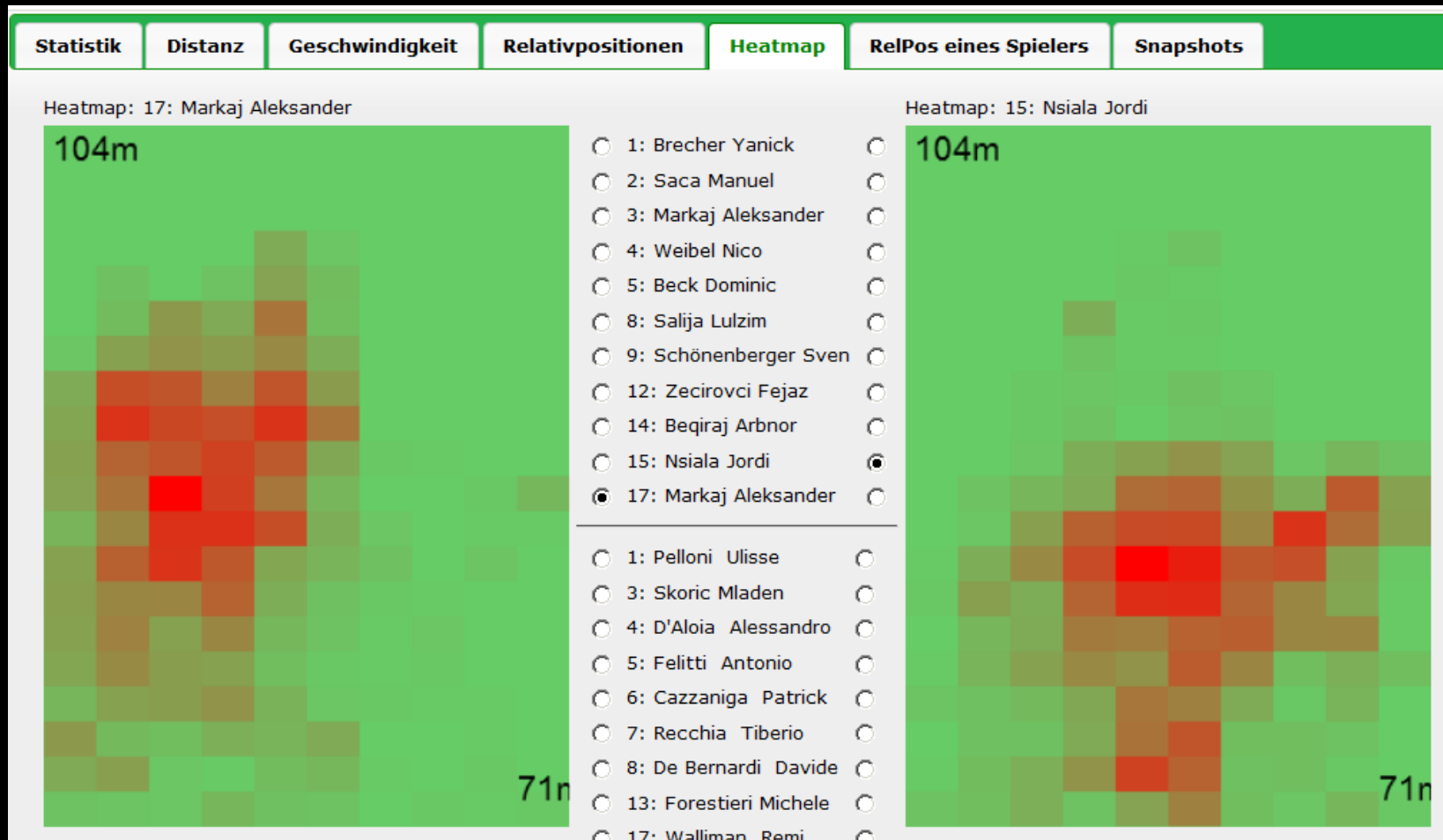




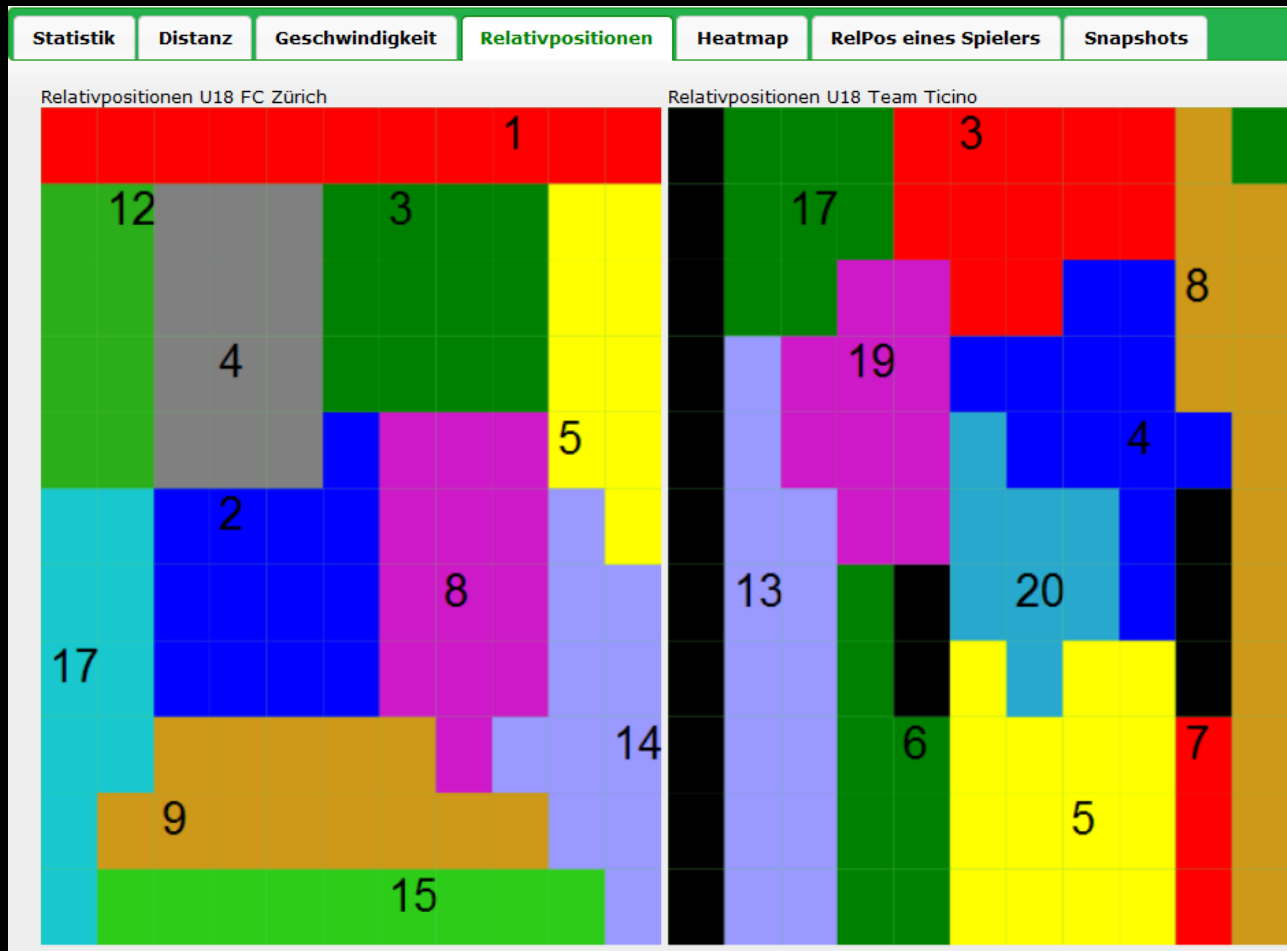
# Vergleich Video und Spielanimation



# Aufenthaltsdauer auf Spielfeld (Heatmap)

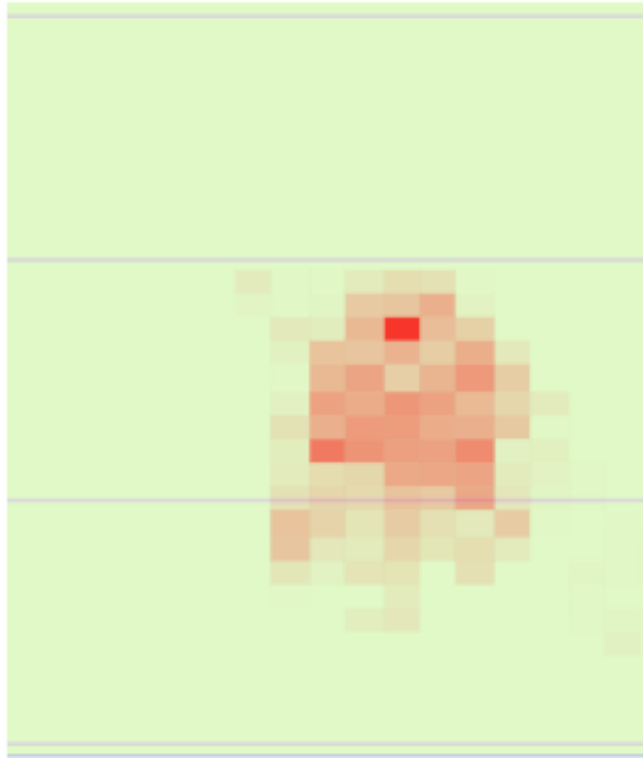


# Relativpositionen aller Spieler

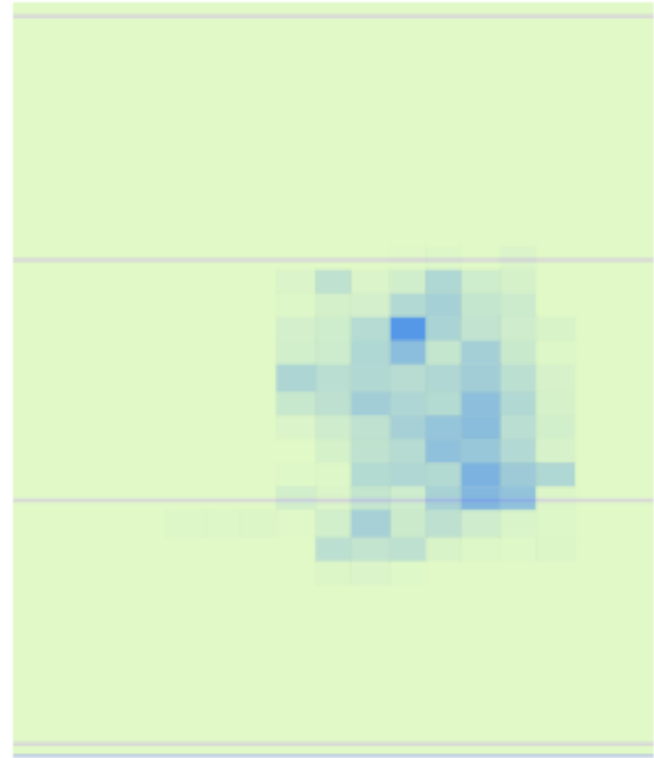


# Center of Team Gravity

U18 FC Zürich



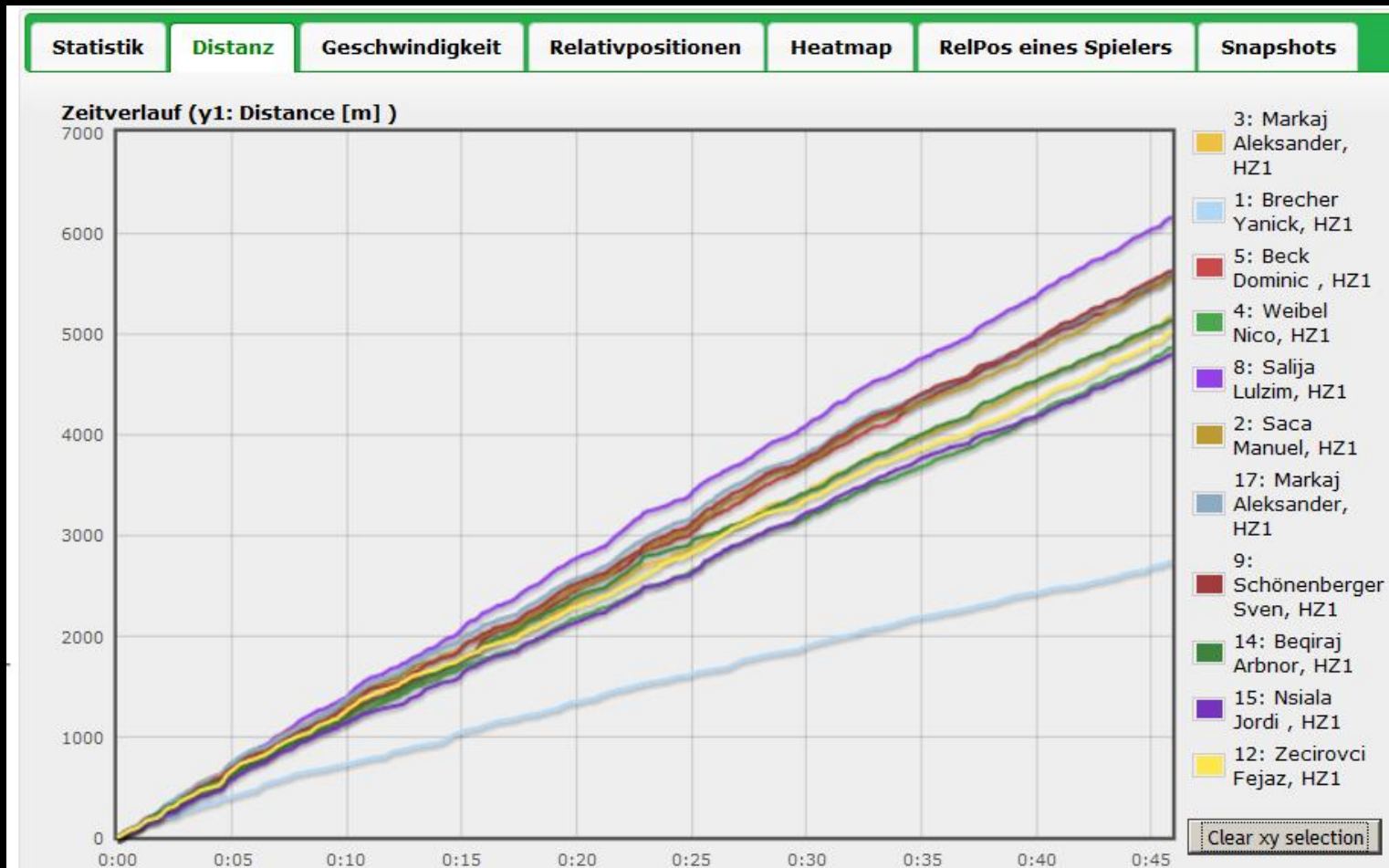
U18 Team Ticino



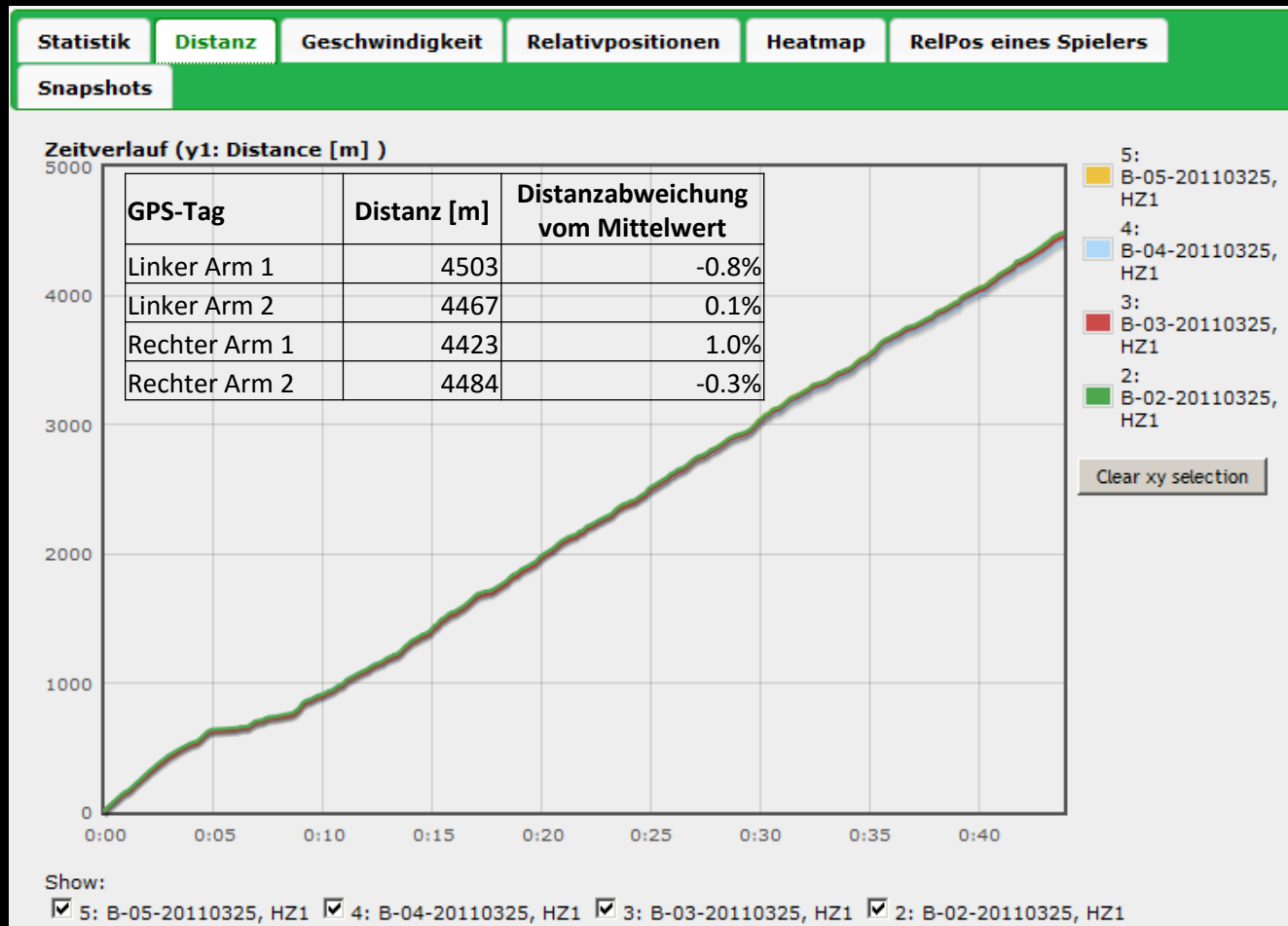
# Auswertungen Leistung (Ausdauer)



# Gelaufene Distanz

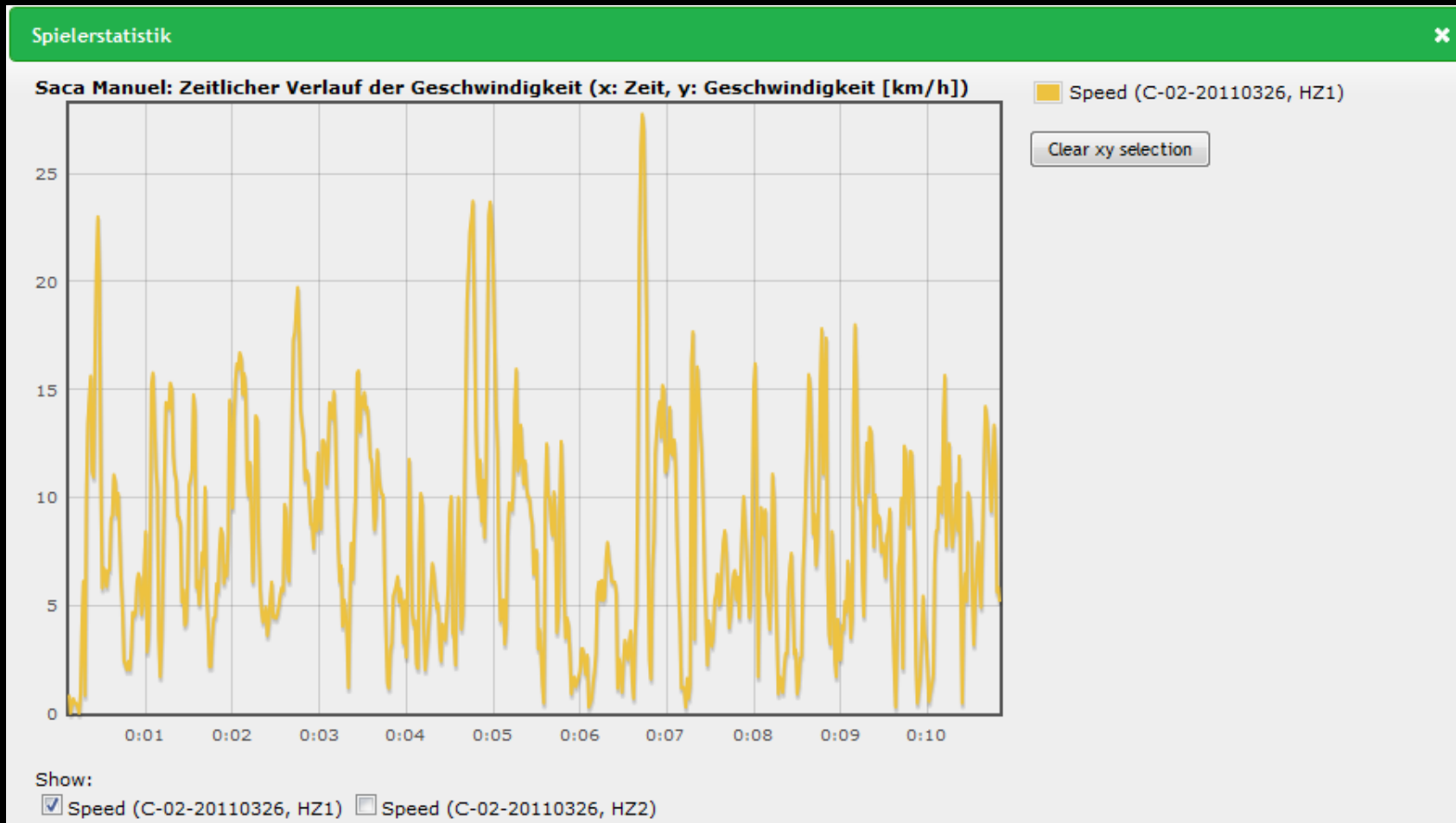


# Genauigkeit Distanzmessung (+/- 1%)

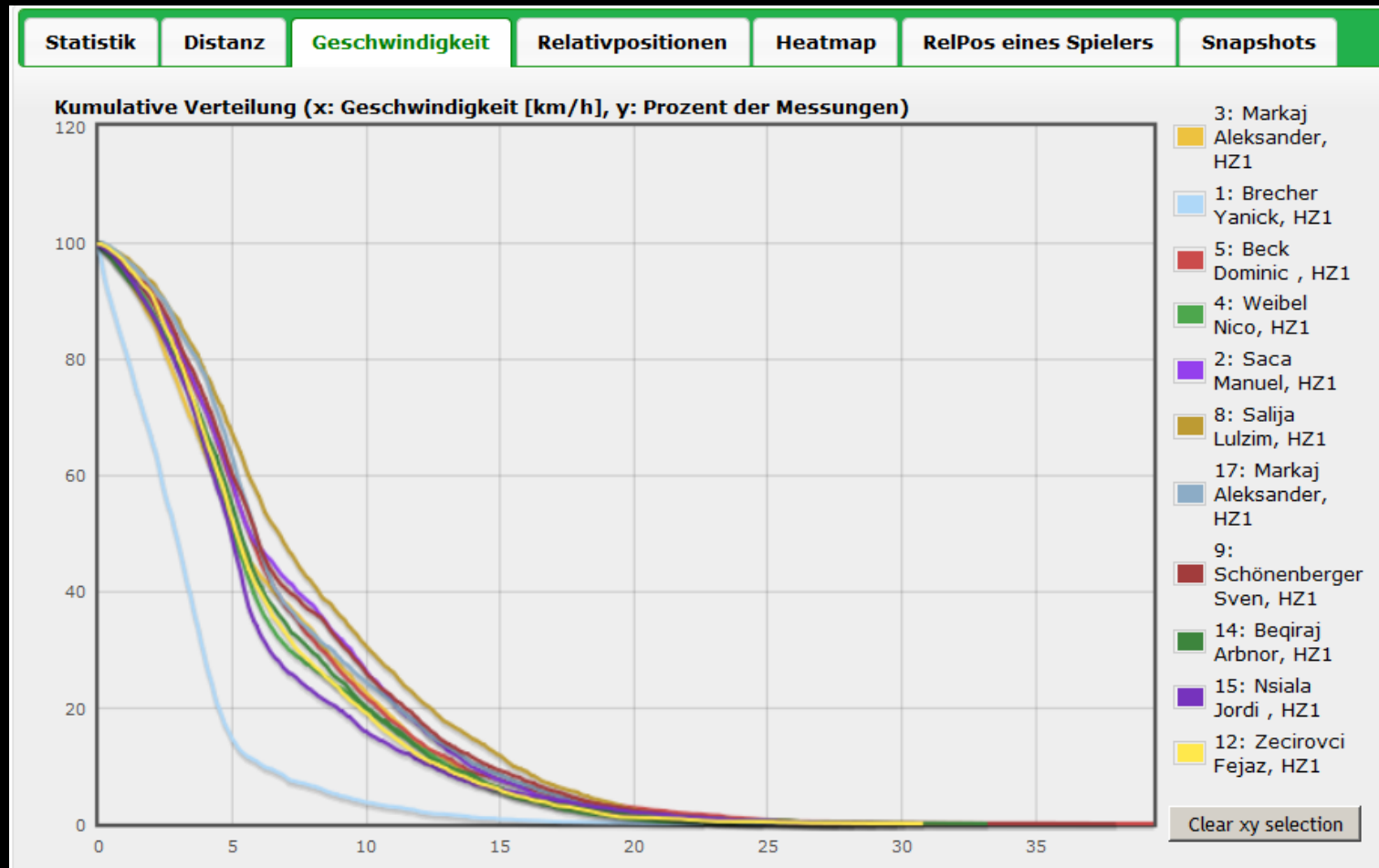


# Auswertungen Schnelligkeit (Sprints)

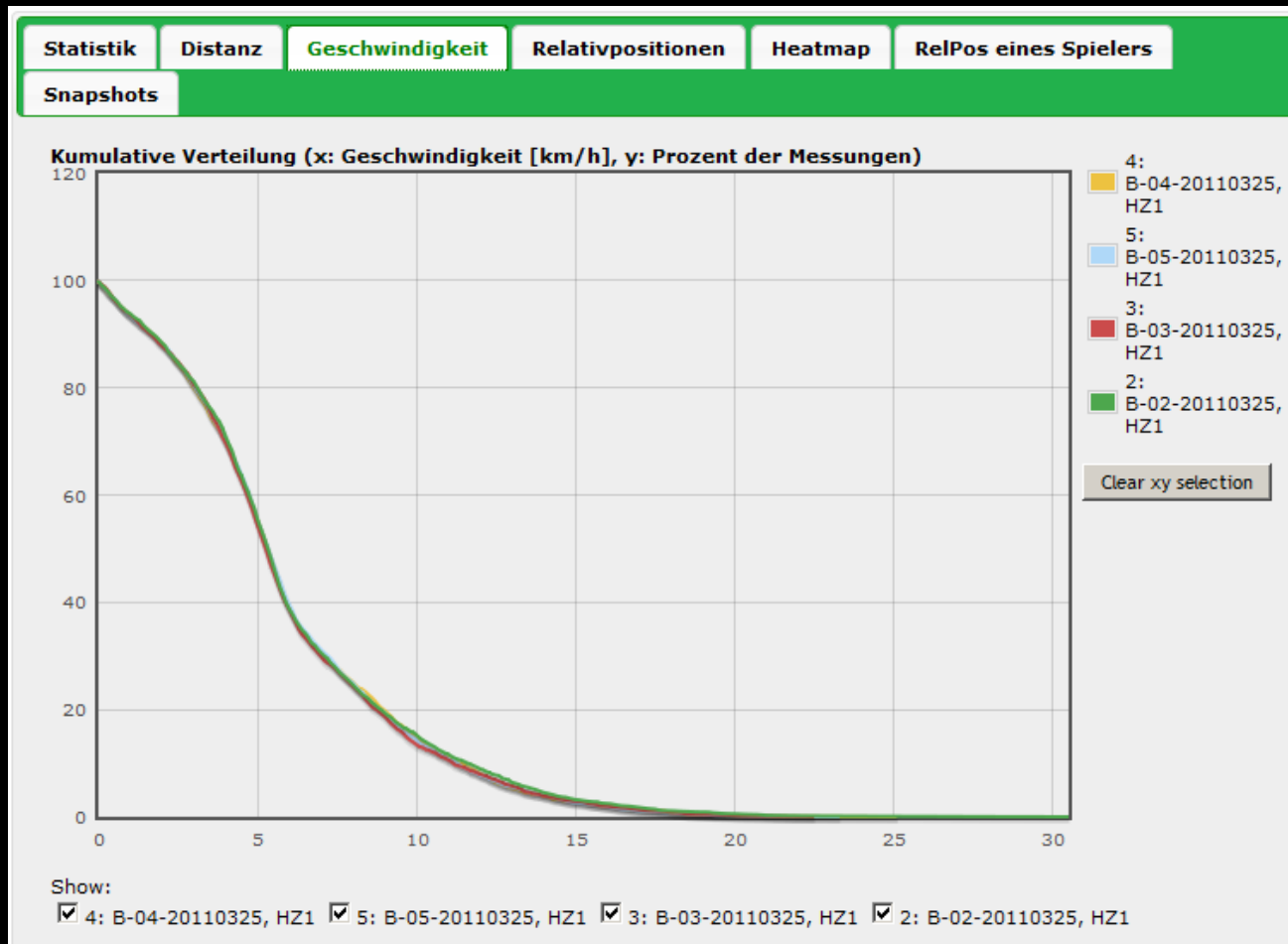
# Zeitlicher Verlauf der Geschwindigkeit eines Spielers



# Geschwindigkeitsverteilung



# Genauigkeit Geschwindigkeitsmessung





# **3. Motion Tracking im Sport**

(Status und Ausblick)

# Catapult (former GPSports) [gpsports.com](http://gpsports.com)



[gpsports.com/gpsports-101](http://gpsports.com/gpsports-101)

[www.catapultsports.com](http://www.catapultsports.com)



# STATSports Viper

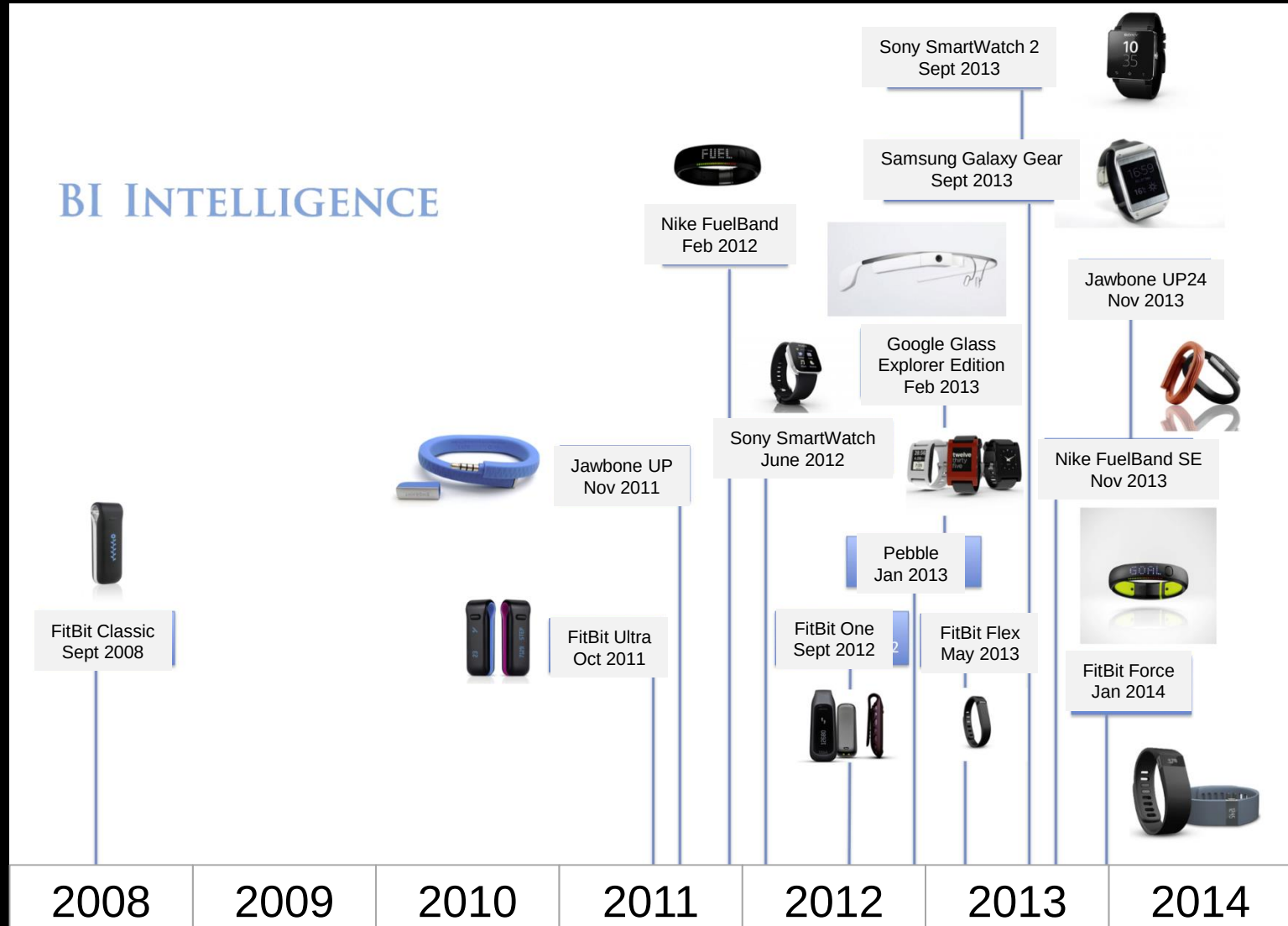
[statsports.com/technology/products](http://statsports.com/technology/products)



- 10Hz GPS module
- 100Hz 3-D accelerometer
- 100Hz 3-D gyroscope
- 10Hz 3-D digital compass
- Long range radio
- Heart rate receiver



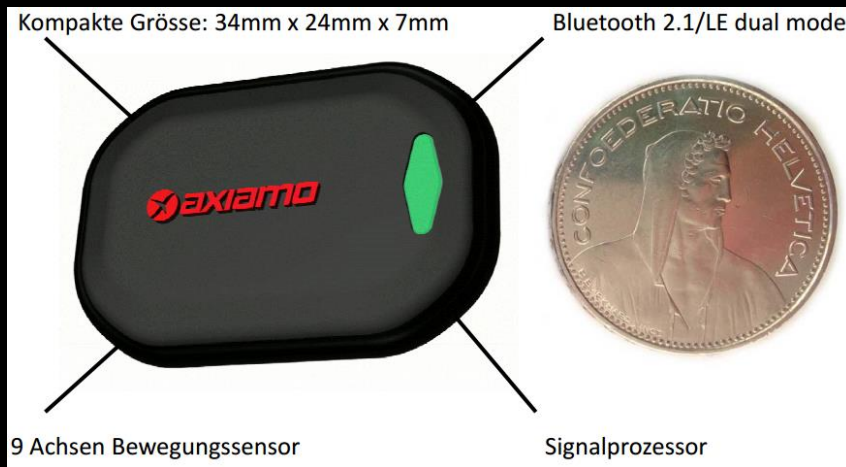
# Wearable Device Release Date Timeline



# Motion, Pulse Sensors und automatische Trainingshilfestellung

## 9-axis motion sensing systems

- Accelerometer
- Gyroscope
- Magnetometer



[www.axiomo.com](http://www.axiomo.com)



[welcome.moov.cc](http://welcome.moov.cc)



# Sensoria's smart footwear and clothing



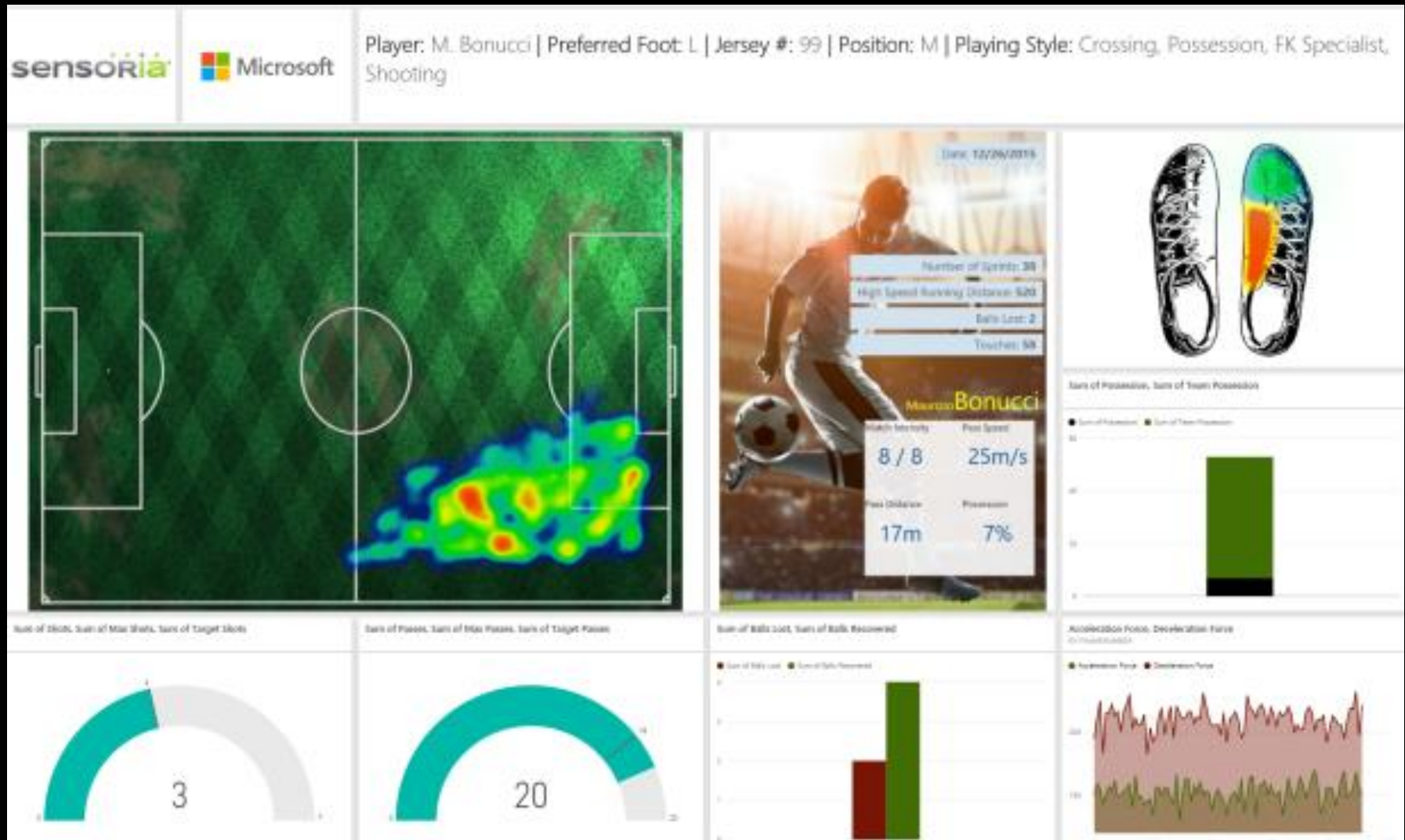
CES 2016, Las Vegas

- collect players' biometric data and track movements
  - pressure sensors located in a soccer boot
  - ultra-low power system on a chip
  - 9-axis MEMS sensor
  - store data
- monitor
  - heart rate
  - accelerations, decelerations
  - passes and shots
  - movements of the player on the field

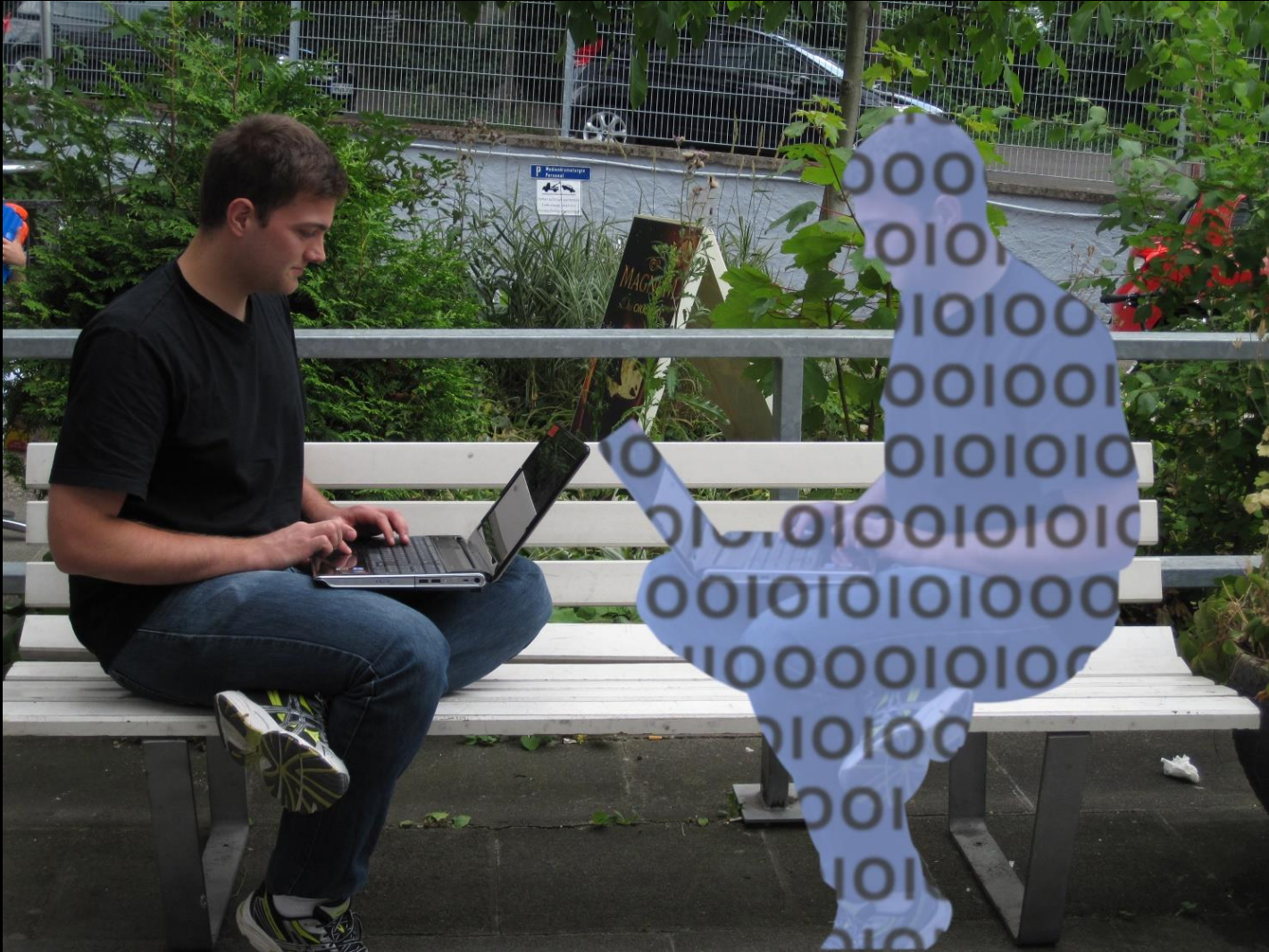




# Microsoft Soccer Dashboard



# Physische vs. virtuelle Identität: Atome vs. Bits



# Changing the soccer transfer market with big data (TEDxTwenteU, 12.3.2015)

**TED** Ideas worth spreading

WATCH

DISCOVER

ATTEND

PARTICIPATE

ABOUT

LOG IN



<https://www.youtube.com/watch?v=UMeDP-IIBD8> 8m32s



# VEREINE - RAIFFEISEN SUPER LEAGUE 2015/16

| Verein                                                                             |                  | Kader | ø-Alter    | Legionäre | Anteil<br>Legionäre [%] | Gesamtmarktwert<br>[MEuro] | ø-Marktwert<br>[MEuro] |
|------------------------------------------------------------------------------------|------------------|-------|------------|-----------|-------------------------|----------------------------|------------------------|
|                                                                                    |                  | 261   | 25,6 Jahre | 127       |                         | 256,08 Mio. €              |                        |
|    | FC Basel 1893    | 28    | 25.5       | 14        | 50%                     | 63.43                      | 2.3                    |
|    | FC Sion          | 28    | 26.8       | 18        | 64%                     | 35.8                       | 1.3                    |
|    | BSC Young Boys   | 25    | 26.1       | 11        | 44%                     | 34.5                       | 1.4                    |
|    | Grasshopper Club | 25    | 23.9       | 13        | 52%                     | 30.6                       | 1.2                    |
|    | FC Zürich        | 26    | 25.8       | 11        | 42%                     | 19.4                       | 0.7                    |
|    | FC St. Gallen    | 28    | 25.9       | 13        | 46%                     | 17.85                      | 0.6                    |
|    | FC Luzern        | 25    | 26.2       | 12        | 48%                     | 16.25                      | 0.7                    |
|    | FC Lugano        | 24    | 24.5       | 16        | 67%                     | 13                         | 0.5                    |
|   | FC Thun          | 25    | 25.8       | 6         | 24%                     | 12.9                       | 0.5                    |
|  | FC Vaduz         | 27    | 25.4       | 23        | 85%                     | 12.35                      | 0.5                    |

# Weitere Informationen

Demobeispiele: [www.cnlab.ch/fussball](http://www.cnlab.ch/fussball)

Folienkopien (PDF)  
[www.cnlab.ch](http://www.cnlab.ch) > Publikationen

HSR Datenschutz Zertifikatskurs:  
Recht – Technik – Organisation  
Do/Fr 9./10. Februar 2017  
[www.hsr.ch/datenschutz](http://www.hsr.ch/datenschutz)

