

Medical Multi-Parameter Monitoring Sports-Shirts

Date : Nov. 30th 2011; Location : SmartTex Symposium 2011, Weimar, Germany



csem 

technologies for innovation
wearable technologies – anytime, anyplace, anywhere



www.csem.ch info@csem.ch

Outline

➤ Medical device technology @ CSEM

➤ Medical multi-parameter monitoring

❖ Introduction

❖ MYHEART system

❖ SENSE system

○ Concept

○ Results

➤ Conclusions

CSEM

... is a research and development company, active in the domains of micro-, nano- and information technology

... is a private company, with mainly industrial, but also public shareholders, not-for-profit

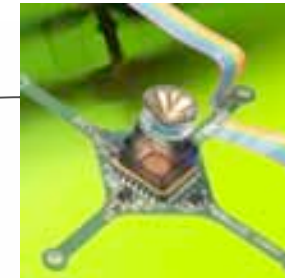
... is under contract by the Swiss Government to perform a special mission in micro- and nanotechnology

... has revenues of 75 MCHF (2010), today ~ 400 employees, five centers in Switzerland & international activities

CSEM centers in Switzerland



Thin films optics



Photonics



Microelectronics
Microsystems technology
Nanotechnology & Life Sciences
System Engineering



Microrobotics



Nanomedicine

Global strategy

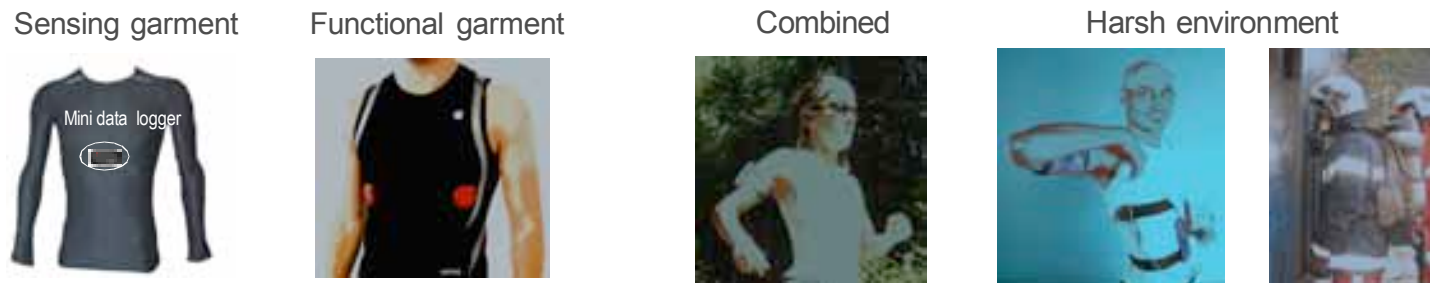
1. Research axis « Human vital sign monitoring »

New sensing concepts and methods for patient monitoring in ambulatory conditions for sports, health care and rehabilitation



2. Research axis « Wearable electronics »

Smart textiles with integrated, low-power and inconspicuous sensing electronics



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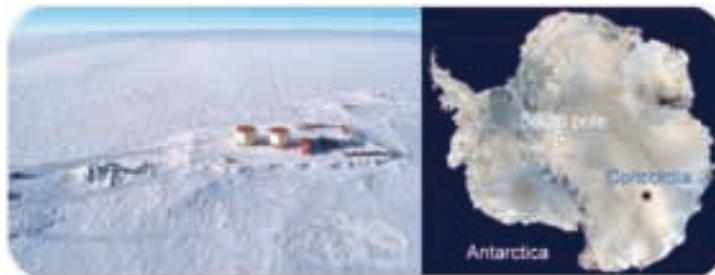
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Space exploration – the LTMS program

- ESA program regarding continuous multi-parameter health monitoring system
- Clinical studies in Antarctica / Concordia
- Human vital sign monitoring concept (24h/24h)
 - ECG
 - Respiration rate
 - Pulse oximetry (SpO₂, HR)
 - Blood pressure (NIBP)
 - Body core temperature (CBT)
 - Pulse wave velocity (PWV)
 - Activity and posture
 - Weight and body composition
- Development roadmap 2001 – 2014

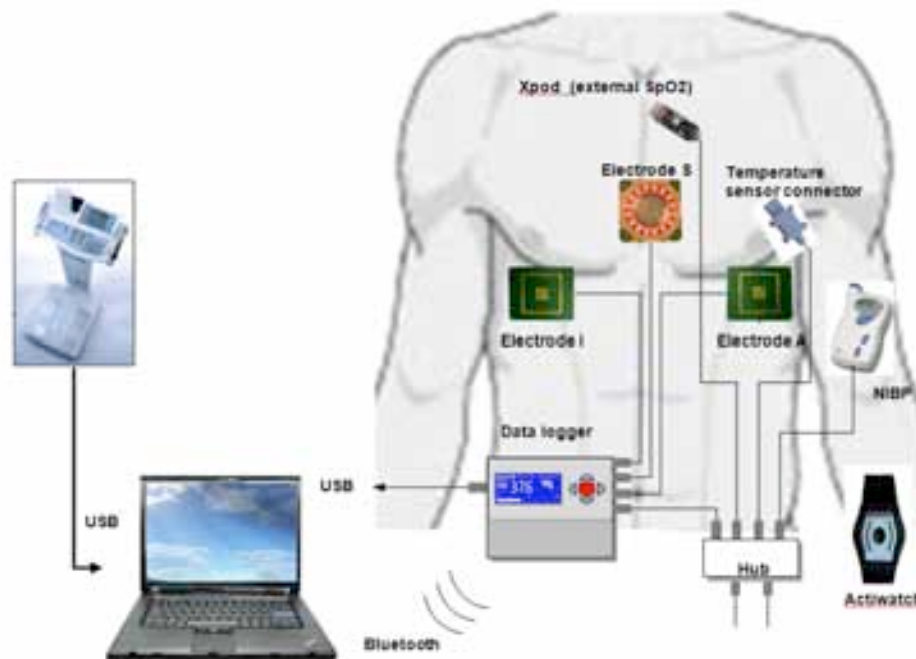


LTMS hardware overview

- **Modular system** with many options
- 24-hour recording
- USB or Bluetooth streaming and downloading
- CSEM's technology integrated with commercial components



LTMS (full option)



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Smart textiles and wellbeing

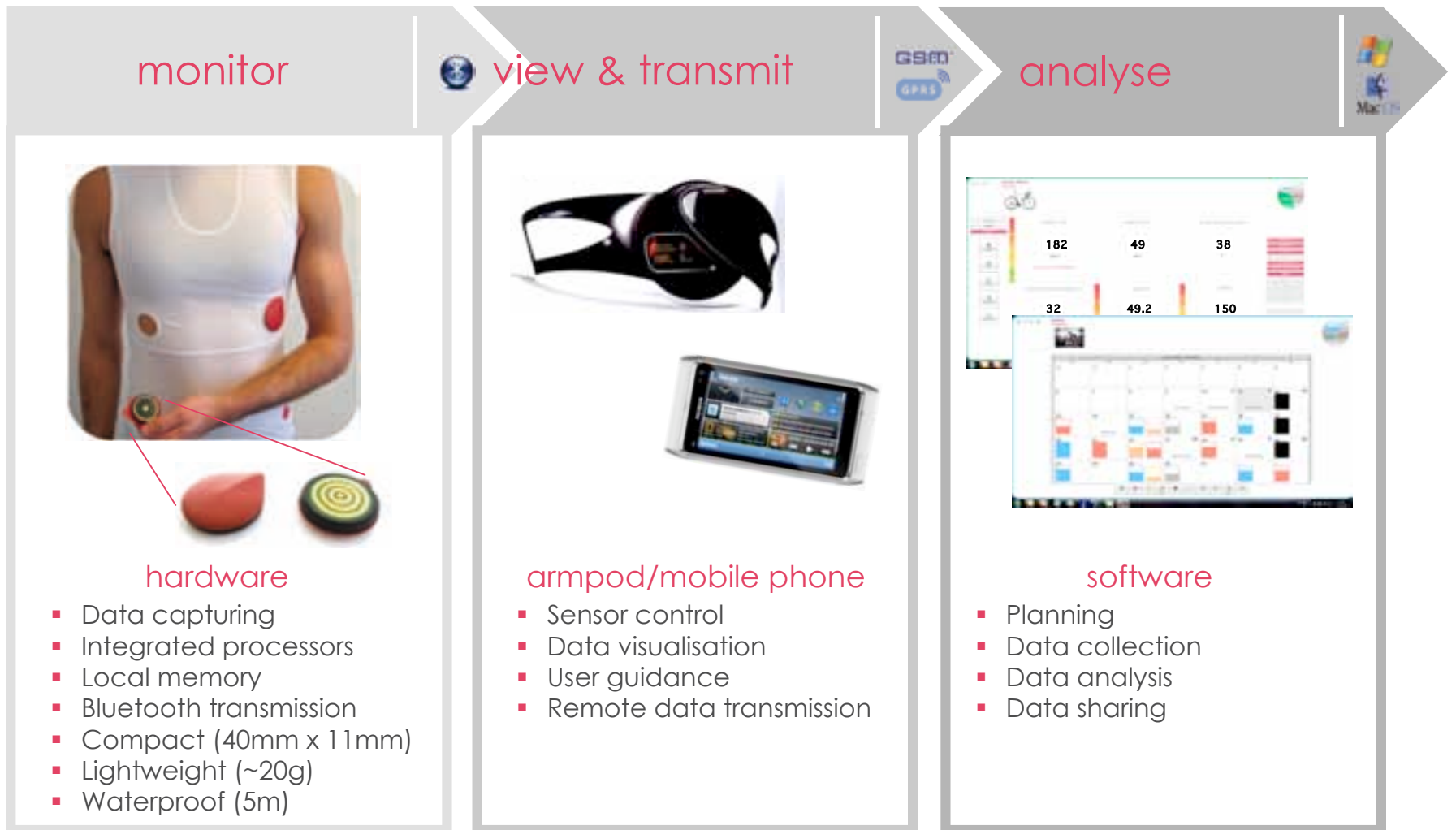
- Commercial repercussion of European project *MyHeart* (FP7)
 - CSEM as technology provider for signal processing tasks and interface and communication electronics as well as industrialization partner (transfer to production)
 - *Smartex* Ltd (Italy) as textile provider with textile electrodes for HR and respiration measurement
 - *Weartech* Ltd (Spain) as commercial partner
- Smart patient monitoring platform
 - Textile with integrated electrodes
 - CSEM's processing and communication electronics
 - Mobile data analysis and visualization platform



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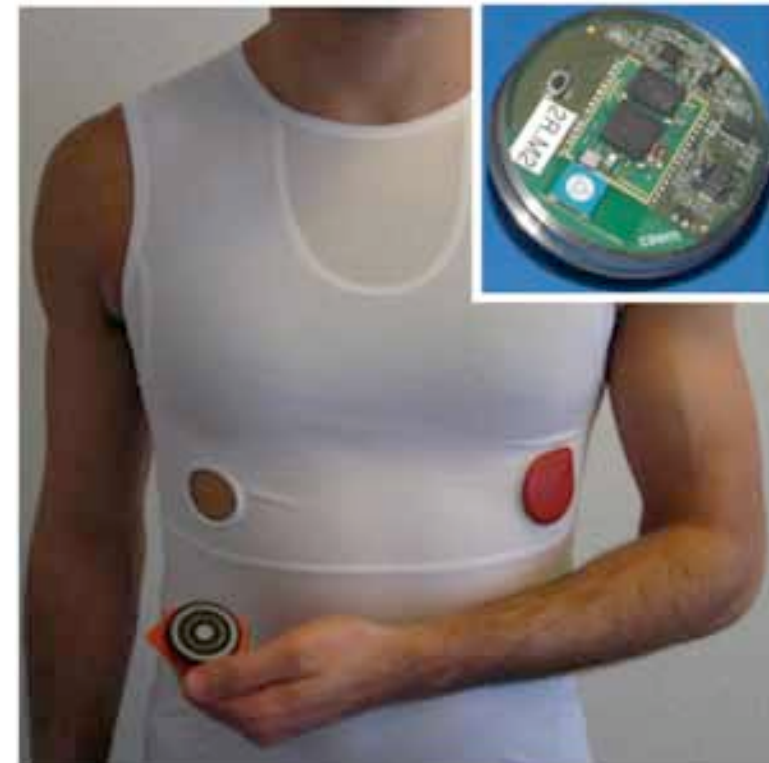
What makes **sense** in sports...



... and the technology behind it.

- **Dry electrodes**, integrated in compression layer-1 garment
- Patented **multi-parameter sensing** and processing platform (8 patents)
- **High integration level** and low-power communications

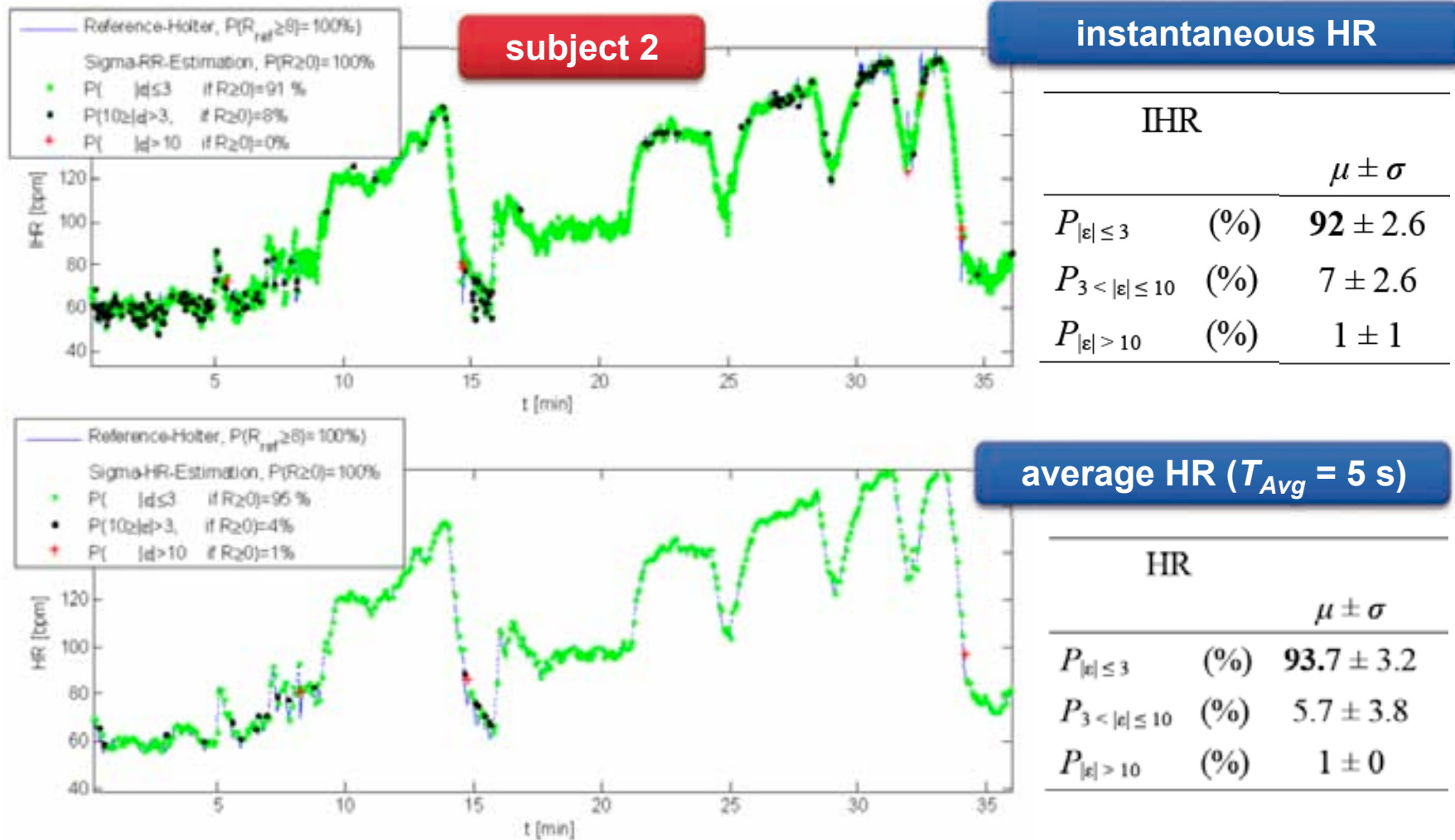
	signal name	remark
measured signals	ECG	compliant with IEC 60601-2-47
	impedance	compliant with IEC 60601-1
	body temperature	skin temperature at electrode sensor
	ambient temperature	at the sensor back
	altitude	derived from pressure sensor
	acceleration	3D
processed signal	IHR	instantaneous heart rate
	HR	heart rate = filtered IHR
	BR	filtered breath rate
	activity class	lying, standing, walking, running, others
	activity level	filtered intensity
	cadence	steps per minute
	speed	running speed
	distance	running distance



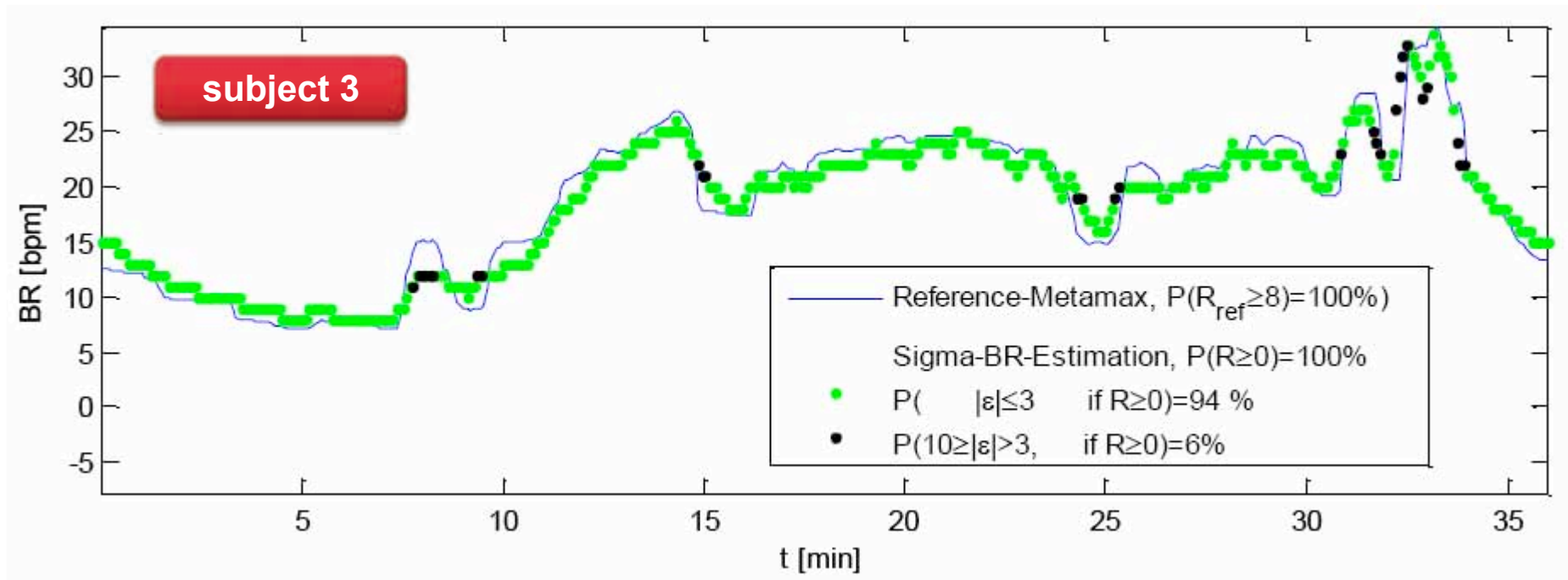
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SENSE heart-rate vs. HOLTER heart-rate



SENSE BR vs. BR derived from Metamax spirometer



SENSE vs. reference

		BR
		$\mu \pm \sigma$
$P_{ \epsilon \leq 3}$	(%)	84 ± 14
$P_{3 < \epsilon \leq 10}$	(%)	14 ± 11.4
$P_{ \epsilon > 10}$	(%)	2 ± 2.6

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Conclusions

- Proven track record and over 10 years of experience in the domain of medical vital signs monitoring for ambulatory applications
- Key competence in system integration (electronics, signal processing)
- Integration of intelligent sensing technologies into smart textiles show promising results for the continuous monitoring of
 - ❖ ECG, heart rate and derived parameters
 - ❖ body-impedance and breath rate
 - ❖ core body temperature
- Commercialization in progress for the sports domain

Thank you for your attention !

