Mobile Systems for Home Monitoring

A comprehensive assessment of Health and Behavior

Topics

1. Getting to know movisens

2. What is Home Monitoring?

3. How to use our systems in Home Monitoring?

4. Future directions

5. Q&A

Getting to know movisens

Getting to know movisens

- Karlsruhe Institute of Technology (KIT) Spin-off

  ➢ Interdisciplinary research group: „Relationship between **stress, physical and mental performance**"

- Established in 2009

  ➢ Headquarter in Karlsruhe
  ➢ 17 Employees
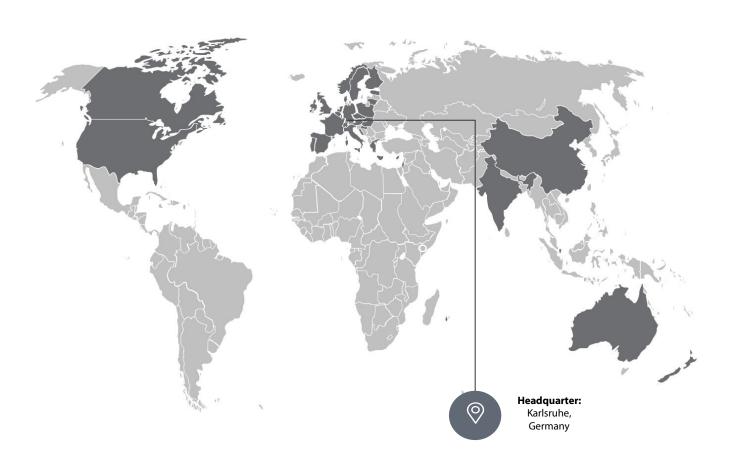
Getting to know movisens
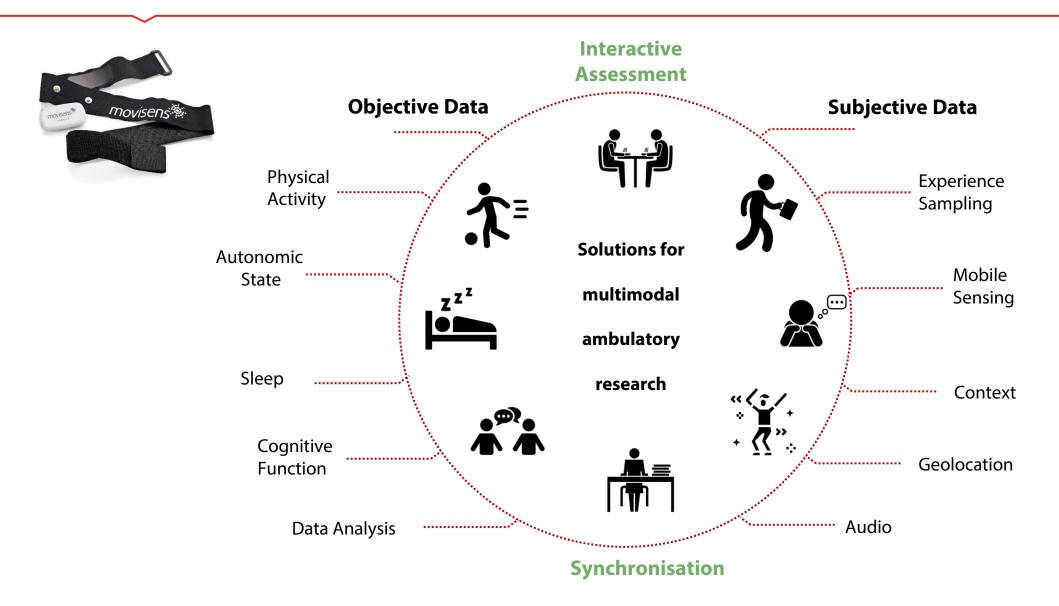
International customer base

Headquarter:
Karlsruhe,
Germany

Our solutions

Interactive Assessment

Objective Data

Subjective Data

Physical Activity

Experience Sampling

Autonomic State

Mobile Sensing

Sleep

Context

Cognitive Function

Geolocation

Data Analysis

Audio

Synchronisation

Solutions for multimodal ambulatory research

Ambulatory Assessment

Real-time assessment → • **Higher Precision Subjective data**

Assessment in everyday life → • **Generalizability**

Repeated assessment → • **Dynamic changes**

Multimodal Assessment → • **Psychology, Physiology, Behaviour, Context**

Interactive Assessment → • **Interventions based on physiology, behaviour and context**

What is Home Monitoring?

Home Monitoring Components
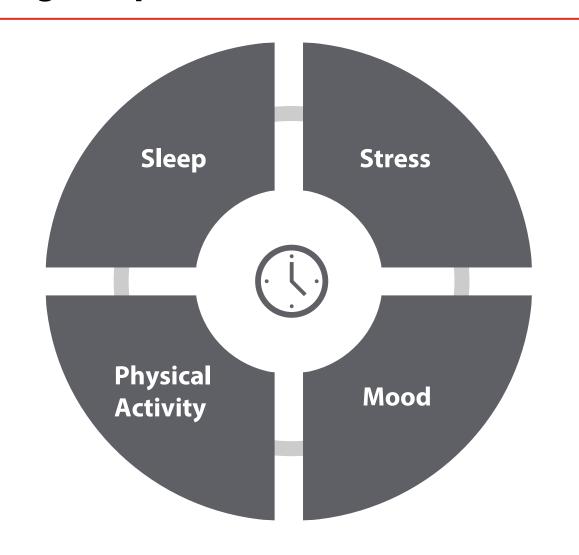

Sleep
Duration
Quality

Physical Activity
Duration
Intensity
Type of activity
Mobility

Stress
Intensity
Stressors

Mood
Self Report
Kontext
Behaviour

What we know about Sleep

- **Definition:** Naturally recurring and easily reversible state that is characterized by reduced consciousness, perceptual disengagement, immobility, and the adoption of a characteristic sleeping posture.

- Vital component of general **health** and **well-being**

- Our internal circadian clock promotes sleep at night

- **Functions**: Energy restoration, metabolic regulation, thermoregulation, strengthening immune system, detoxification, brain maturation,…

Sleep disorders are on the rise…

- Sleep disorders, psychological disorders and (secondary) diseases rise within our population as a consequence of modern living

- Use of artificial light has changed humanity's sleep patterns

- Data show that only 25-30 % of adults obtain the recommended 7-8 hours a night and 20-35 % report consistent sleep difficulties (Robbins et al. 2019)

How we can measure physical activity

- **Definition:** Accelerometry is the Measurement of body movements with the aid of an electronic device

- An **accelerometer** is a device that measures acceleration by assessing the inertial force on a known test mass.

- Activity Sensor
  - The Accelerometer is the most important component of an activity sensor, other sensors can also be incorporated – such as pressure sensors or gyroscopes

- **Validity** of subjective self-reports regarding physical activity is very low: Correlation r = 0.41

- Accelerometers allow continuous, objective recording **in everyday life**

- Accelerometers are based on the measurement of acceleration

- Algorithms allow the calculation of
  - Intensity / Energy expenditure
  - Activity classes (sitting, walking…)
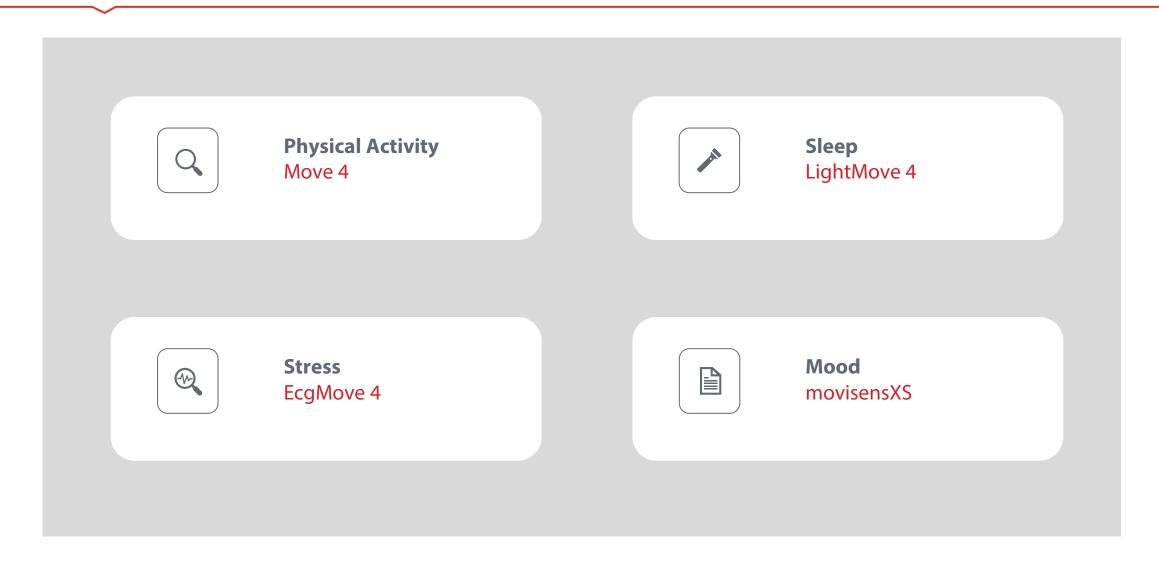 - Body position (lying, sitting, standing…)

Experience Sampling

- **Definition:** Recording of subjective thoughts, **mood** and behaviour of participants at the moment of the event in everyday life

- At specified times (sampling), the respondent is asked to submit a self-report.

- Classic **questionnaire**
  - Participant estimates the memories with mental "rule of thumb"
  - Retrospective reports are distorted

- **Mobile sensing** is increasingly becoming part of normal life due to the development of smartphone technology and the increasing integration of sensors

- Traditional smartphones are equipped with a variety of sensors that capture **user activity** and **context**.

- These functions can be used profitably in Home Monitoring.

- Use of mobile available data in order to assess the context and the situation of the respondent with regard to the question in the best possible way.

How to use Ambulatory Assessment in Home Monitoring?

Our solutions for Home Monitoring

Physical Activity
Move 4

Sleep
LightMove 4

Stress
EcgMove 4

Mood
movisensXS

movisens

Product overview

Move 4
3D Activity Sensor

- 3D Acceleration, 3D-Gyro, Air Pressure, Temperature
- activity recognition
- energy expenditure measurement
- **Bluetooth Low Energy Interface**
- **live algorithms**

EcgMove 4
ECG and Activity Sensor

- 1-channel ECG, 3D Acceleration, 3D-Gyro , Air pressure, Temperature
- Chest strap or adhesive electrodes
- **Bluetooth Low Energy Interface**
- **live algorithms**

LightMove 4
Ambient Light and Activity Sensor

- Ambient light (5 channels) 3D Acceleration, 3D-Gyro, air pressure, temperature
- Sleep analysis and behaviour monitoring
- Interactive Ambulatory Assessment
- **Bluetooth Low Energy Interface**
- **live algorithms**

Product overview

EdaMove 4
EDA and Activity Sensor

- Electrodermal activity (EDA), 3D acceleration, 3D-Gyro, air pressure, temperature
- long-term measurement
- Exosomatic method, constant voltage
- **Bluetooth Low Energy Interface**
- **live algorithms**

DataAnalyzer
Software for sensor data analysis

- Calculation of secondary parameters
- Generation of reports
- data export
- Fully automatic study evaluation

movisensXS
Electronic diary / questionnaire

- Platform for Experience Sampling
- Sustainable technology based on Android
- Flexible sampling strategies and wide choice of item formats
- Collection of qualitative and quantitative data
- **Mobile Sensing**
- **Coupling with all the movisens sensors**

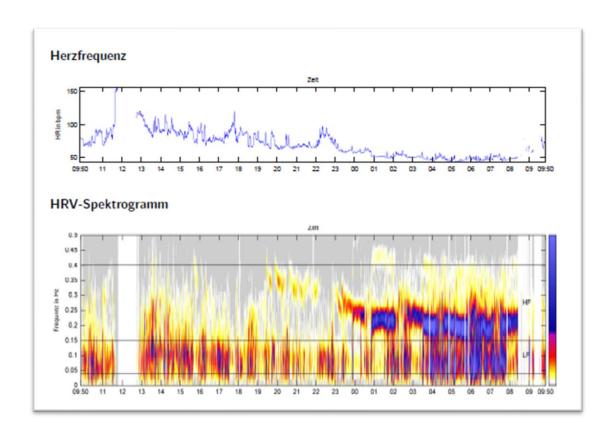# Determining nonwear and sleep/wake states

- Essential for estimating **sleep duration** based on actigraphy data

- Non-wear detection from actigraphy data based on influence of respiration wave on the power spectrum

- **Best results:** Chest-worn accelerometer (Bland-Altman analysis)

Source: Barouni et al. (2020) – Ambulatory sleep scoring using accelerometers – distinguishing between nonwear and sleep/wake states

Assessment of Stress

- Measurement of Heart Rate (HR) and Heart Rate Variability (HRV)

- Reduced HR during night

- Increased HRV (parasympathetic activity)

- Comparison between day and night

Subjective mood assessment

The experience Sampling Platform movisensXS is a possibility to collect subjective information in addition to the objective sensorical measurement of sleep

Smartphone based questionnaires can capture the participants feelings and context

Participants can set their own time to receive an alarm followed by a questionnaire
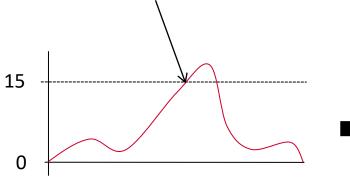
Interactive Ambulatory Assessment

Sensors

- Physiological signals
- Self-report
- Context (e.g. call)
- Location

+

Trigger conditions

15

0

- Heart rate > 150
- Answer = Yes
- Call duration > 5 min
- At Home

→

Actions

- Fill in self report
- Start intervention
- Send alarm

Room for questions

Send us your questions in the group chat!

Get in Touch!

Meet our Research Consultant Team

Dr. Stefan Hey
Research Consultant
+49 (721) 381344-16

Darren McLennan
Research Consultant
+49 (721) 381344-20

Jana Schlicksupp
Research Consultant
+49 (721) 381344-18