

# Unobtrusive Sensor system to measure behavioural and physiological parameters during the night

Samuel E.J. Knobel<sup>1</sup>, Stephan M. Gerber<sup>1</sup>, Michael A. Single<sup>1</sup>, Angela A. Botros<sup>1</sup>, Narayan Schütz<sup>1</sup>, René M. Muri<sup>1,2</sup>, Urs Mosimann<sup>1</sup>, Tobias Nef<sup>1,2,3</sup>

<sup>1</sup> Gerontechnology & Rehabilitation Group, University of Bern, Switzerland

<sup>2</sup> Department of Neurology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland

<sup>3</sup> ARTORG Center for Biomedical Engineering Research, University of Bern, Switzerland

**Introduction:** Inadequate or disturbed sleep is one of the most frequent neurological disorder and often leads to cognitive impairment, fatigue and altered mood and thus an increased risk of accidents in daily life. The gold standard for the diagnosis of sleep disorders is the multiparametric test Polysomnography (PSG) during the nightly sleep. In order to monitor the body functions during the PSG a lot of obtrusive cables are attached to the body and therefore, usually takes place in the hospital, a foreign environment for the patient. With advances in technologies, new and less obtrusive wearable and nearable sensing devices have been developed. Further, in recent years an increasing number of studies have shown a high correlation between unobtrusively assessed body function and the gold standard PSG. Therefore, the aim of the case study was to test an unobtrusive multimodal sensor system for diagnosis of sleep disorders, which can be used at home.

**Method:** The study was conducted at the NeuroTec Loft (SITEM, Inselspital) a modern instrumented home-like apartment. During an overnight stay of a healthy volunteer the body functions were assessed (vital- and movement parameters) by a contactless unobtrusive multimodal sensor system. The sensor system included the technologies ballistocardiograph, pressure, infrared and radar.

**Results:** The case study showed that all relevant vital- (heart rate, breathing rate, heart rate variability) and movement parameters (leg movements, body movements) could be assessed. The sensors system additionally measured sleep parameters like time in bed or sleep efficiency.

**Conclusion:** Overall, unobtrusive contactless sleep measurements have a great potential to measure important vital- and sleep parameters non-inferior to the obtrusive gold standard PSG at home. In addition, the system has the possibility to monitor the progression of sleep disorders at home and thus prevent patients from accidents in daily life.

**Key words:** Sleep, Contactless Monitoring, Instrumented Apartment, Sensors