

## **A Sensor Network for Monitoring Physical Activity Type and Energy Expenditure in Field Studies**

### **Abstract**

A system is introduced, able to classify different activity types and predict average daily energy expenditure (EE) in real life situations using two accelerometers and a heart rate monitor. The models used for the prediction of physical activity (PA) type and EE were developed under lab conditions and validated under restricted lab condition, in simulated free-living conditions as well as in subjects habitual environments for 2 weeks. 7 classes of PA type could be recognized under free-living conditions with an overall accuracy of 78%. The average accuracy for EE prediction was 88% for isolated measurements, 55% for free activities and 87% and 91% for the estimation of average daily EE over the period of 1 and 2 weeks, validated against the Doubly Labelled Water (DLW) method, which is accepted as the gold standard for EE measurement in field studies.

### **Conclusion**

We introduced a sensor network that is unobtrusive enough to be worn for weeks in normal everyday life. We have shown, that two accelerometer sensors mounted on the thigh and the upper arm suffice to recognize 7 activity classes known to be important contributors to daily EE. Furthermore we have shown that the classification of basic PA types increases the accuracy of EE estimates under free-living conditions. Even though the classification was less accurate using the ShakeNet system, an overall classification accuracy of 78% can be expected under free-living conditions. ADL mostly consists of seated and standing activities which are PA types that can be accurately detected. Accurately estimating EE for short periods of time remains a challenge, but it is EE accumulated over days and weeks that matter in the understanding of life-style related diseases. This approach combines the advantages of subjective and objective measurement instruments. As with questionnaires and diaries it can detect PA types and can accurately estimate average daily EE on a population level. Since it is a sensor-based approach it can objectively measure frequency and duration of PA episodes.