

ON-BODY INERTIAL SENSOR LOCATION RECOGNITION

**Dirk Weenk*, Bert-Jan J. F. van Beijnum, Salma Goaid, Chris T. M. Baten,
Hermie J. Hermens and Peter H. Veltink**

*University of Twente, Faculty of EEMCS, Biomedical Signals and Systems
P.O. Box 217, 7511 AE Enschede, the Netherlands
e-mail: D.Weenk@utwente.nl
Web page: <http://www.utwente.nl/ewi/bss>

ABSTRACT

Introduction and past research: In previous work we presented an algorithm for automatically identifying the body segment to which an inertial sensor is attached during walking [1]. Using this method, the set-up of inertial motion capture systems becomes easier and attachment errors are avoided. The user can place (wireless) inertial sensors on arbitrary body segments. Then, after walking for a few steps, the segment to which each sensor is attached is identified automatically. To classify the sensors, a decision tree was trained using ranked features extracted from magnitudes, x - y - and z -components of accelerations, angular velocities and angular accelerations.

Method: Drawback of using ranking and correlation coefficients as features is that information from different sensors needs to be combined. Therefore we started looking into a new method using the same data and the same extracted features as in [1], but without using the ranking and the correlation coefficients between different sensors. Instead of a decision tree, we used logistic regression for classifying the sensors [2]. Unlike decision trees, with logistic regression a probability is calculated for each body part on which the sensor can be placed. To develop a method that works for different activities of daily living, we recorded 18 activities of ten healthy subjects using 17 inertial sensors. Walking at different speeds, sit to stand, lying down, grasping objects, jumping, walking stairs and cycling were recorded. The goal is – based on the data of single sensor – to predict the body segment to which this sensor is attached, for different activities of daily living.

Results: A logistic regression classifier was developed and tested with 10-fold cross-validation using 31 walking trials of ten healthy subjects. In the case of a full-body configuration 482 of a total of 527 (31 x 17) sensors were correctly classified (91.5%).

Discussion: Using our algorithm it is possible to create an intelligent sensor, which can determine its own location on the body. The data of the measurements of different daily-life activities is currently being analysed. In addition, we will look into the possibility of simultaneously predicting the on-body location of each sensor and the performed activity.

REFERENCES

- [1] D. Weenk, B. J. F. van Beijnum, C. T. M. Baten, H. J. Hermens, and P. H. Veltink, “Automatic identification of inertial sensor placement on human body segments during walking”, *Journal of NeuroEngineering and Rehabilitation* 2013, 10:31 pp. 1-9, <http://dx.doi.org/10.1186/1743-0003-10-31>
- [2] I. H. Witten, E. Frank: *Data Mining: Practical Machine Learning Tools and Techniques*. second edition. San Francisco: Morgan Kaufmann Publishers; 2005.