AUTOMATIC IDENTIFICATION OF INERTIAL SENSORS ON THE HUMAN BODY SEGMENTS

Weenk D[1], van Beijnum BJF[1], Veltink PH[1]
[1]University of Twente, Faculty of EEMCS, Biomedical Signals and Systems, Enschede, The Netherlands

INTRODUCTION

In the last few years, inertial sensors (accelerometers and gyroscopes) in combination with magnetic sensors was proven to be a suitable ambulatory alternative to traditional human motion tracking systems based on optical position measurements. While accurate full 6 degrees of freedom information is available [1], these inertial sensor systems still have some drawbacks, e.g. each sensor has to be attached to a certain predefined body segment.

The goal of this project is to develop a 'Click-On-and-Play' ambulatory 3D human motion capture system, i.e. a set of (wireless) inertial sensors which can be placed on the human body at arbitrary positions, because they will be identified and localized automatically.

METHODS

In this study the automatic identification (or classification) of the inertial sensors is investigated, i.e. the automatic assessment of the body segment to which each inertial sensor is attached.

Walking data was recorded from ten healthy subjects using an Xsens MVN motion capture system with full body configuration (17 inertial sensors). Subjects were asked to walk for about 5-8 seconds at normal speed. After rotating the sensor data to the global frame and aligning the walking directions for all the subjects with the positive x-axis, features as variance, mean, and correlations between sensors were extracted from x, y and z-components and from magnitudes of the accelerations and angular velocities. As a classifier a decision tree based on the C4.5 algorithm was developed (with cross-validation) using Weka (Waikato Environment for Knowledge Analysis).

RESULTS

From 31 walking trials (527 sensors), 523 sensors were correctly classified (99.24%). For left/right identification inter-axis correlation coefficients were used. The accelerations of sensors on the right side of the body showed higher correlations between the positive y-axis (pointing to the left) and the positive x-and/or z-axis (pointing to the front and/or up) than the accelerations of sensors on the left side of the body.

DISCUSSION AND CONCLUSION

For human walking, most of the inertial sensors can be identified automatically. Other daily-life activities will be investigated next.

REFERENCES

[1] D. Roetenberg, H. Luinge, and P. Slycke. 6 DOF Motion Analysis Using Inertial Sensors. In Proceedings of Measuring Behavior 2008 (6th International Conference on Methods and Techniques in Behavioral Research), pages 14–15, Maastricht, The Netherlands, August 2008.