Measuring the Variability of Human Movement

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PROBLEM

Variability is an inherent characteristic of human movement [1]. Generally, humans perform the same action slightly differently trial by trial. For these reasons we are interested in studying methods that can give insight into the variability between individuals and repetitions of the same movement. We believe that this preliminary study might provide useful information for activity recognition, e.g. in terms of detecting changes of user's behaviour (enthusiasm, boredom, tiredness or confusion) in the way in which activities are performed over the course of training, practice or rehabilitation.

ACTIVITY RECOGNITION

Activity Recognition Chain (ARC) for intertial sensors [2] where traditional feature extraction techniques are time domain, frequency domain and discrete domain [3].
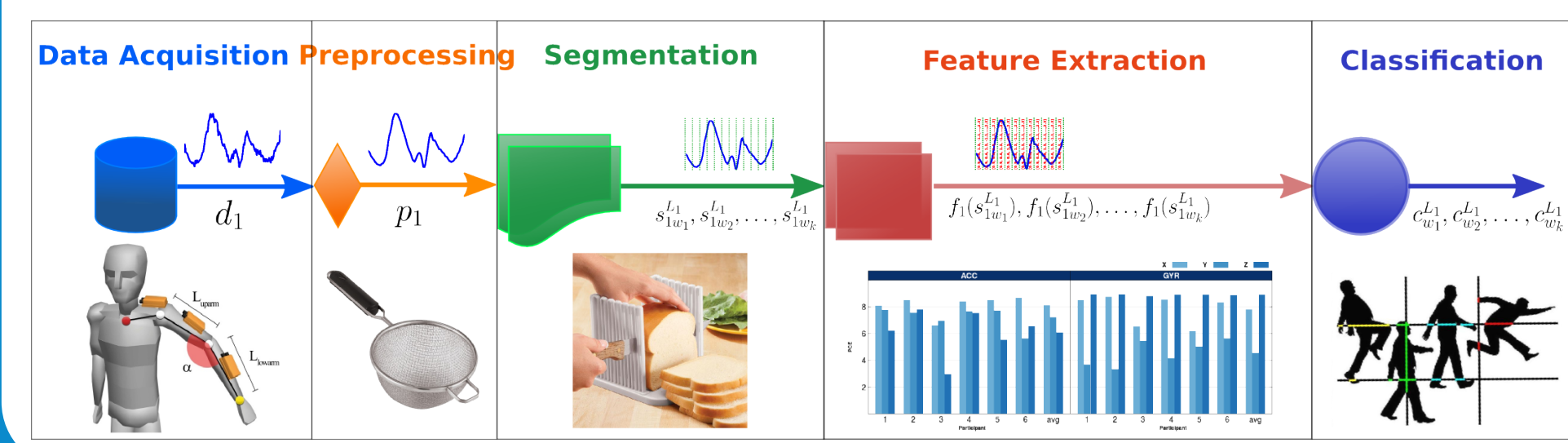
MATERIALS AND METHODS

Raw time-series data is collected from a triaxial accelerometer (a_x, a_y, a_z) and a triaxial gyroscope (g_x, g_y, g_z). Then, a N samples length time-series, e.g. a_x, is used to obtain the time-delay embedded matrix, $E\{a_x\}$, with $m = 20$ and $\tau = 6$ [4, 5]. Finally, PCA is applied to $E\{a_x\}$ to compute the percentage of cumulative energy [6]. The method is applied to six simple movements which were performed by six participants wearing an intertial sensor on their right wrist, each movement were continuously repeated for 20 seconds.

CONCLUSION AND OUTLOOK

Measuring variability in human activity offers an approach to understand user's performance over the course of training, practice or rehabilitation. In the future, we will collect data from a wider range of individuals (gender and age) and from additional sensors. Also, different classification techniques will be explored.
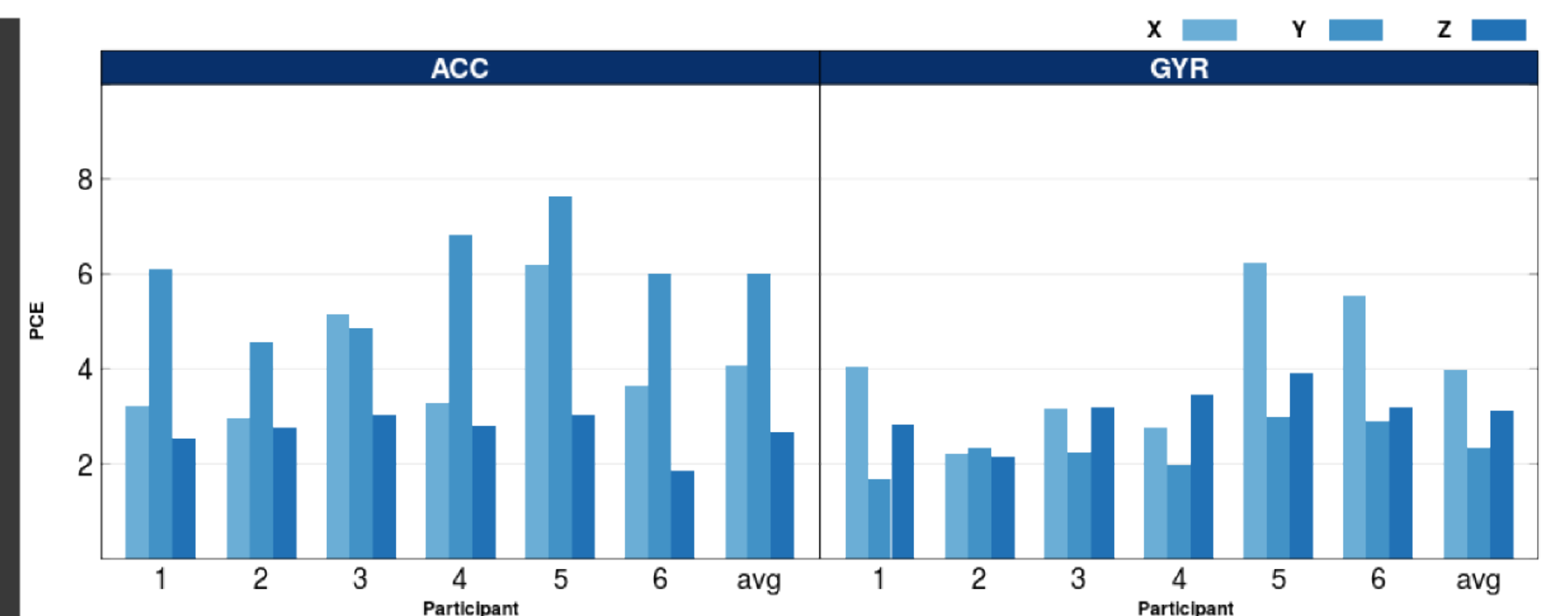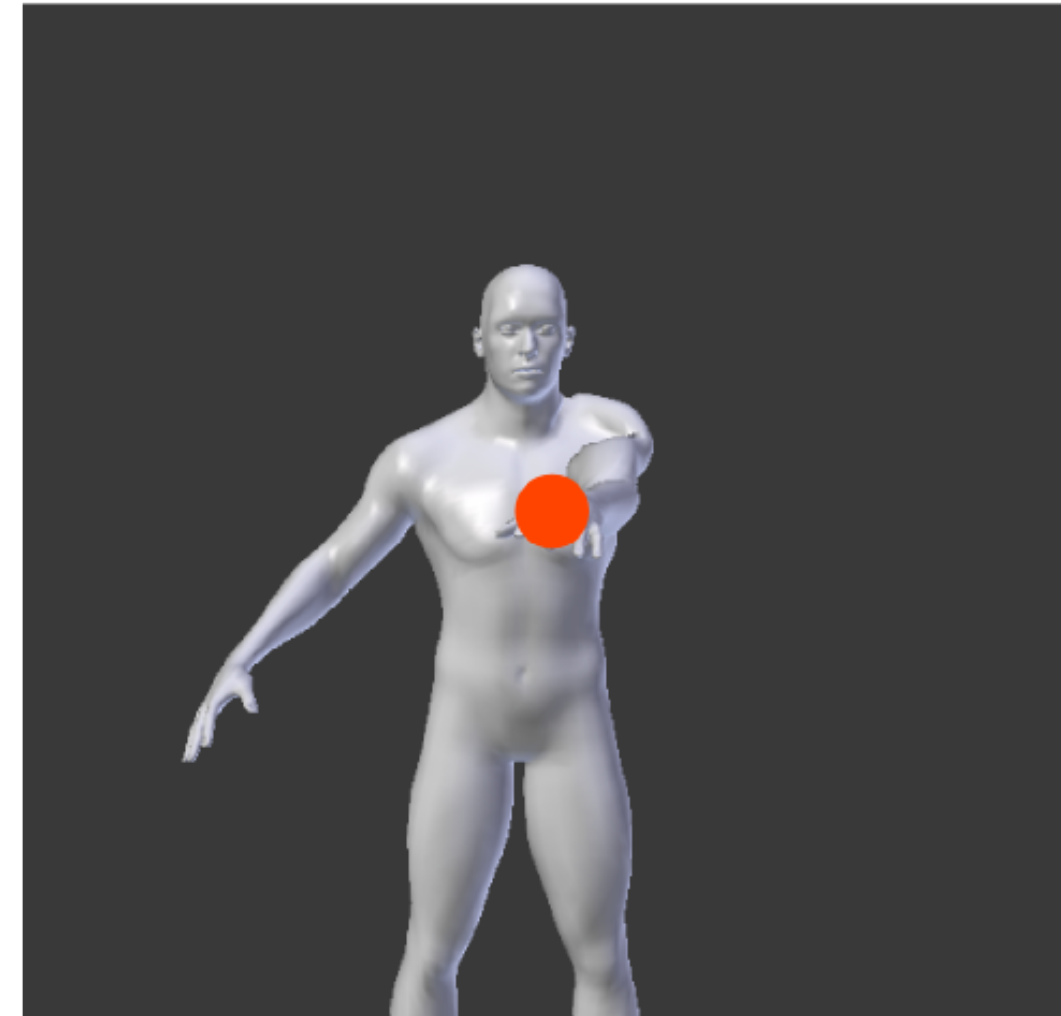
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[3] Davide Figo, Pedro C. Diniz, Diogo R. Ferreira and João M. P. Cardoso. 2010. Preprocessing techniques for context recognition from accelerometer data. In *Personal and Ubiquitous Computing*, 7, 645-662.

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[6] Nils Y Hammerla, Thomas Plötz, Peter Andras and Patrick Olivier. 2011. Assessing Motor Performance with pca. In *International Workshop on Frontiers in Activity Recognition using Pervasive Sensing*, 18-23.

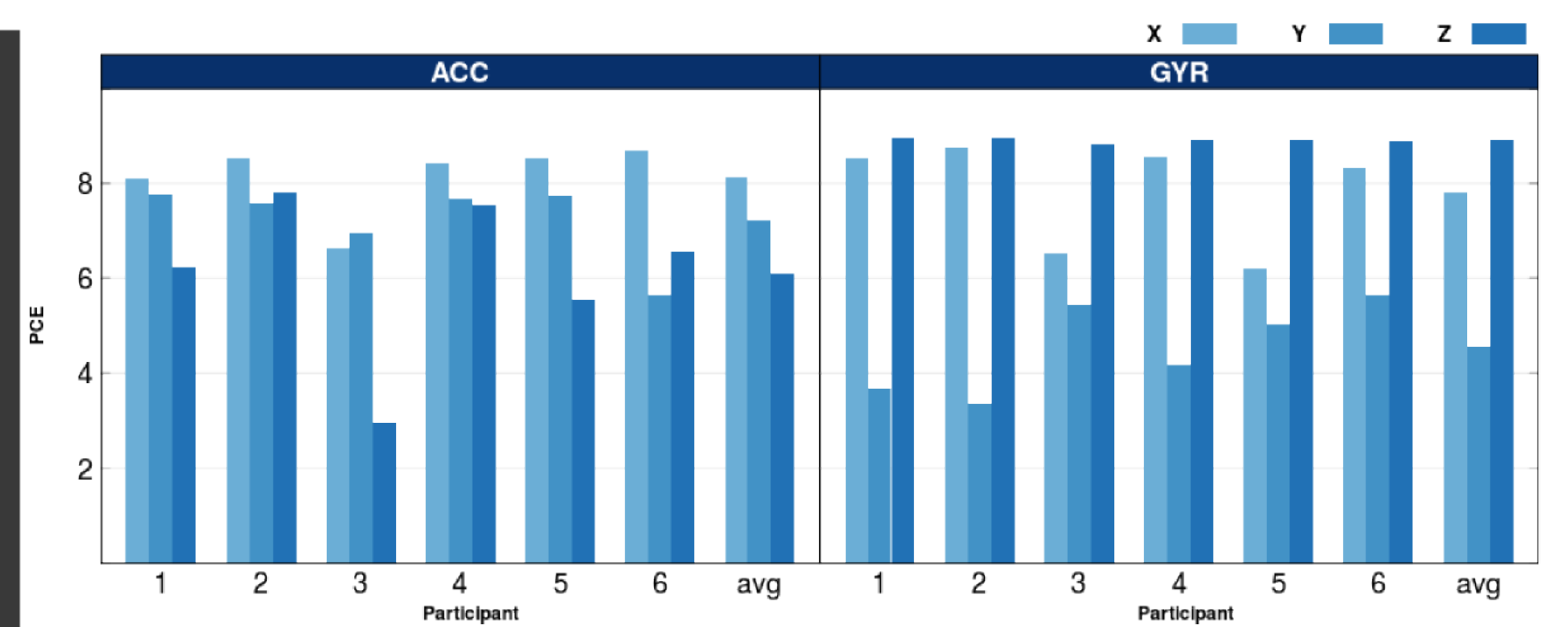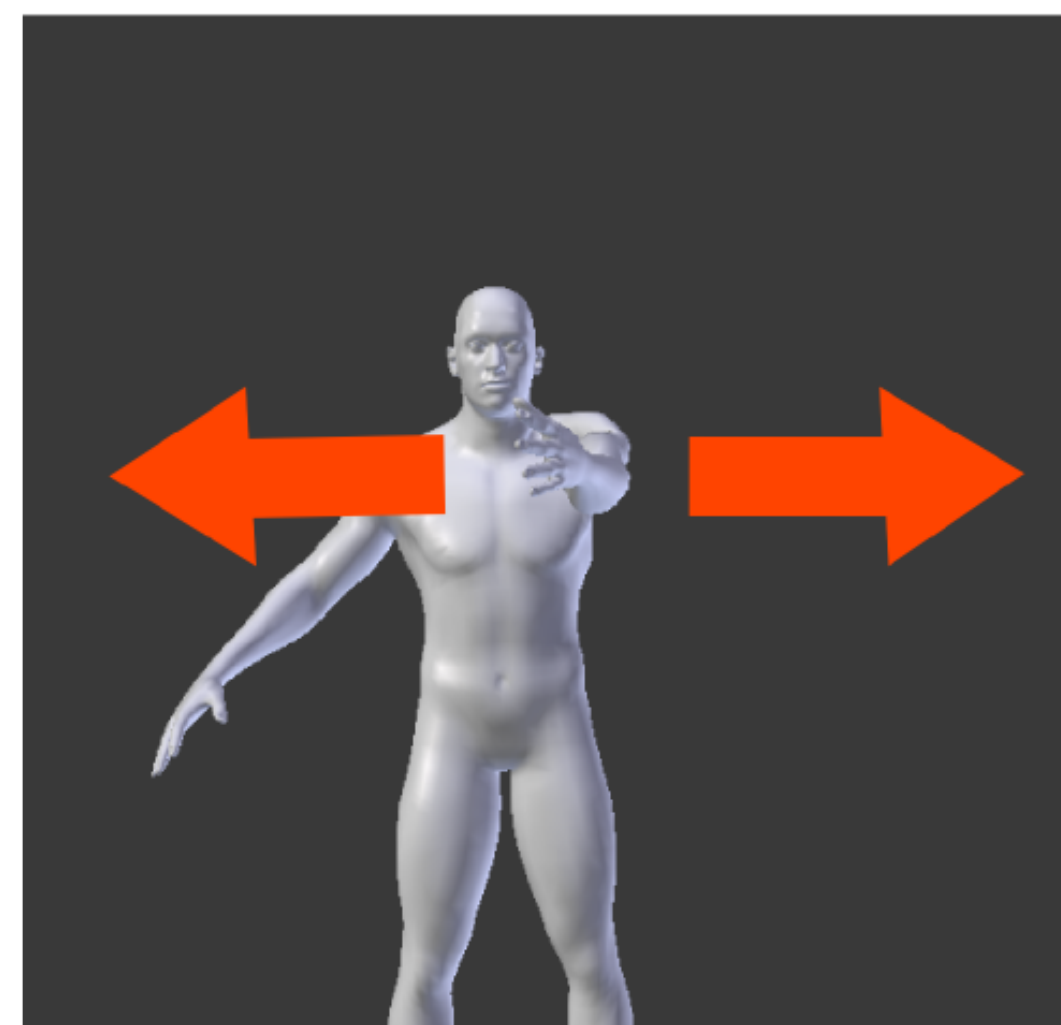## VARIABILITY OF SIMPLISTIC MOVEMENTS

The values of percentage of cumulative energy (PCE) are presented for triaxial accelerometer (ACC) and triaxial gyroscope (GYR) sensors accross partipants and their average denoted by "avg".

It is apparent that circular and 8-shape movements show a constant trend between participants; however, such a trend is not evident for the other movements. We assume that the evident variability for the static, horizontal, vertical and diagonal movements is due to the flexibility in the experiment where participants were only asked to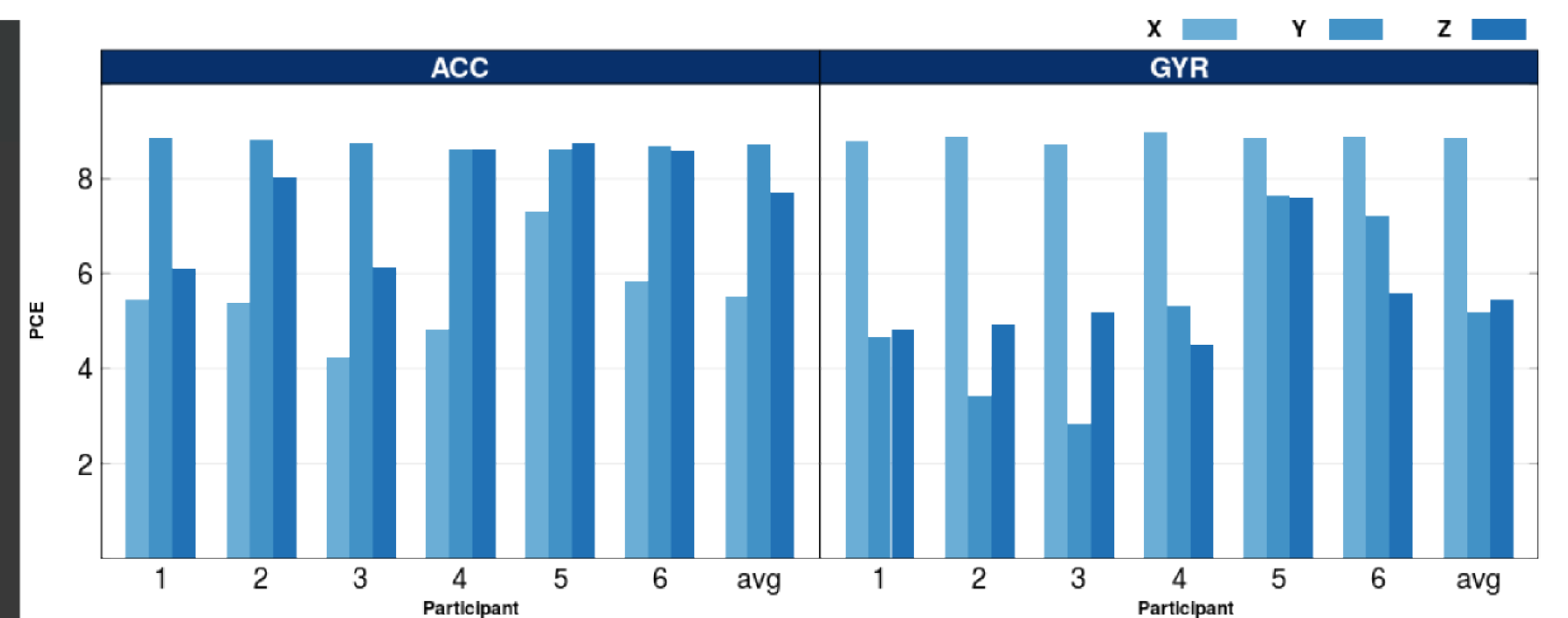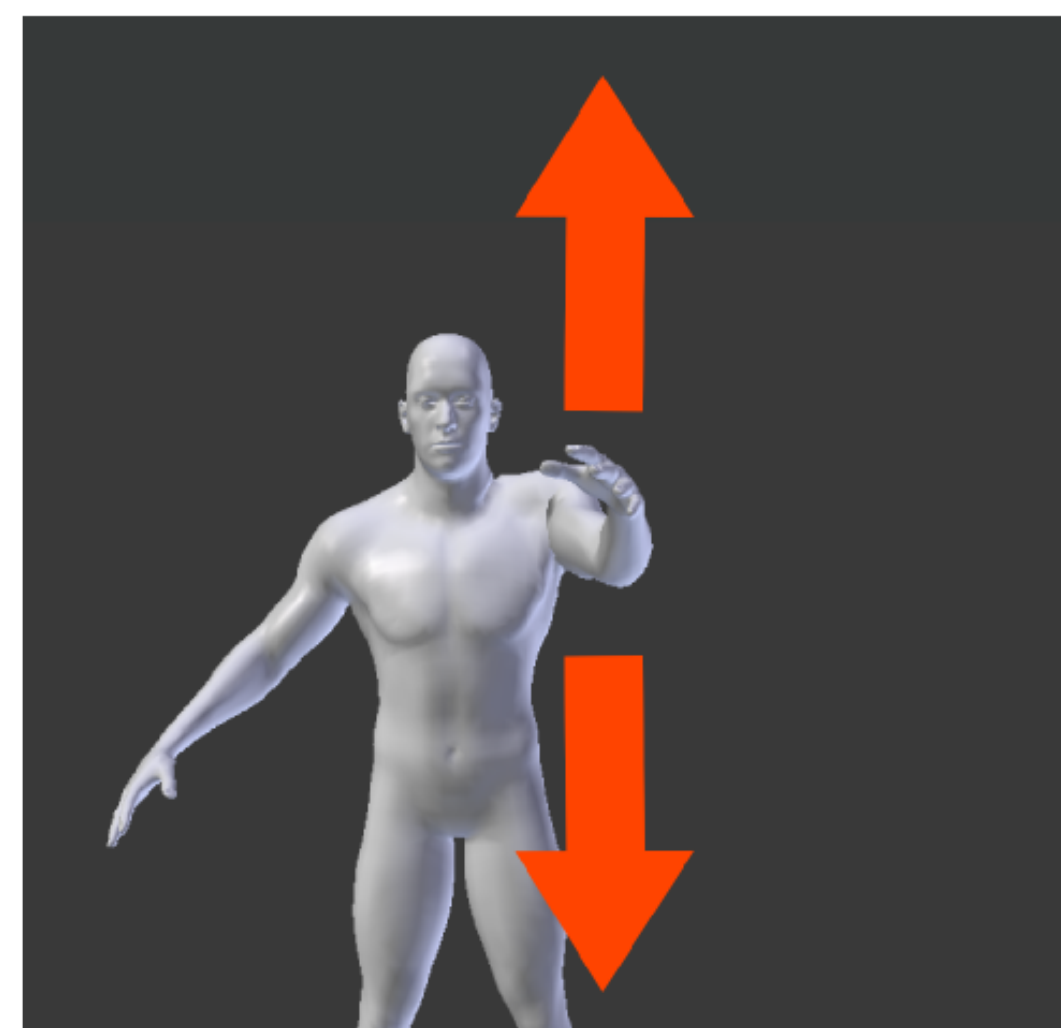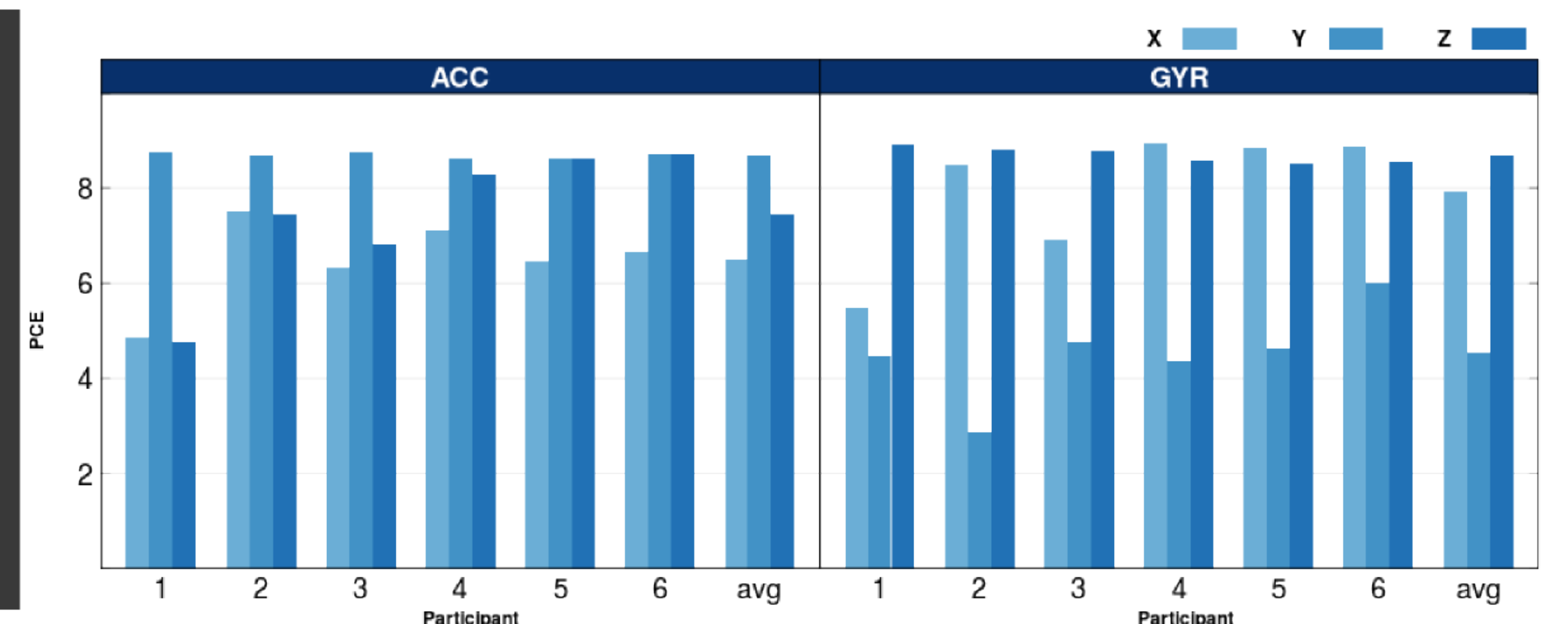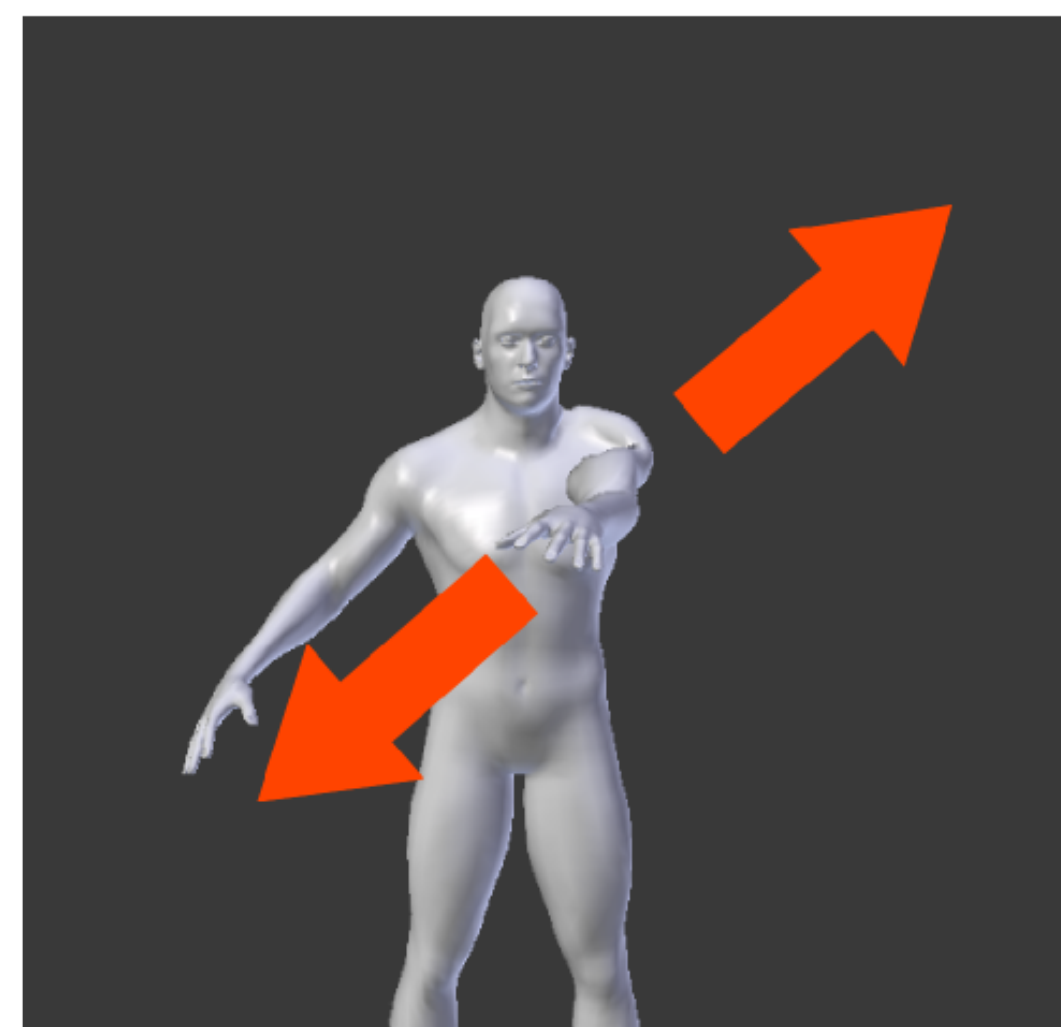 perform the movements at a comfortable speed.