ESTIMATING FULL-BODY POSES WITH NEURAL NETWORKS USING FIVE INERTIAL SENSORS

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Background

Full-body motion capture requires a large number of markers/sensors. Wide availability of motion capture data made it possible to decrease such number by using data-driven methods. Although examples of systems that use a reduced sensor set can be found in literature, they either require cameras or are highly computational expensive.

Objective

To prove that neural networks are capable of estimating full-body poses using only five inertial sensors placed at the lower arms/legs and the pelvis.

Method

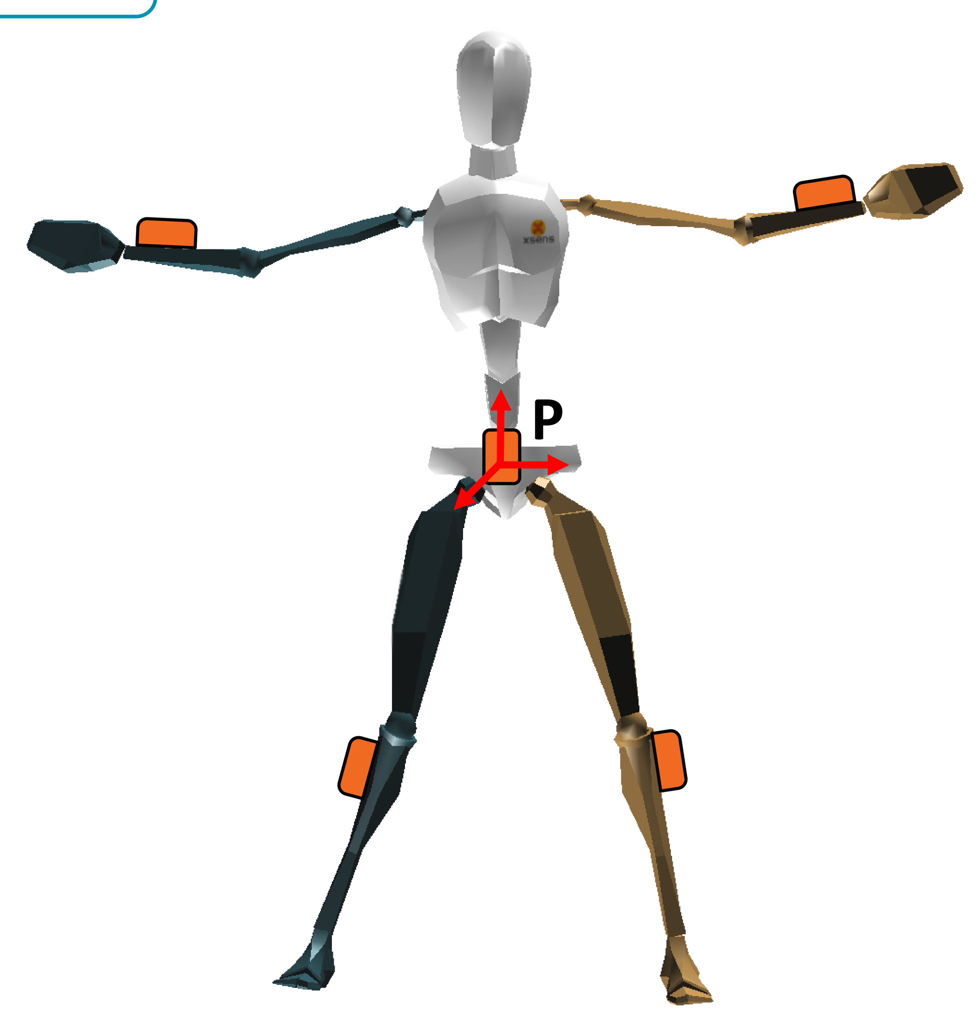

Figure 1: Sensor placement.

Fulll-body movements of 6 subjects were captured using Xsens MVN. The full-body poses were used to define the output of our method. Whereas orientation data of a reduced sensor set (placed as shown in Figure 1) was used to provide inputs to train a neural network (Figure 2).

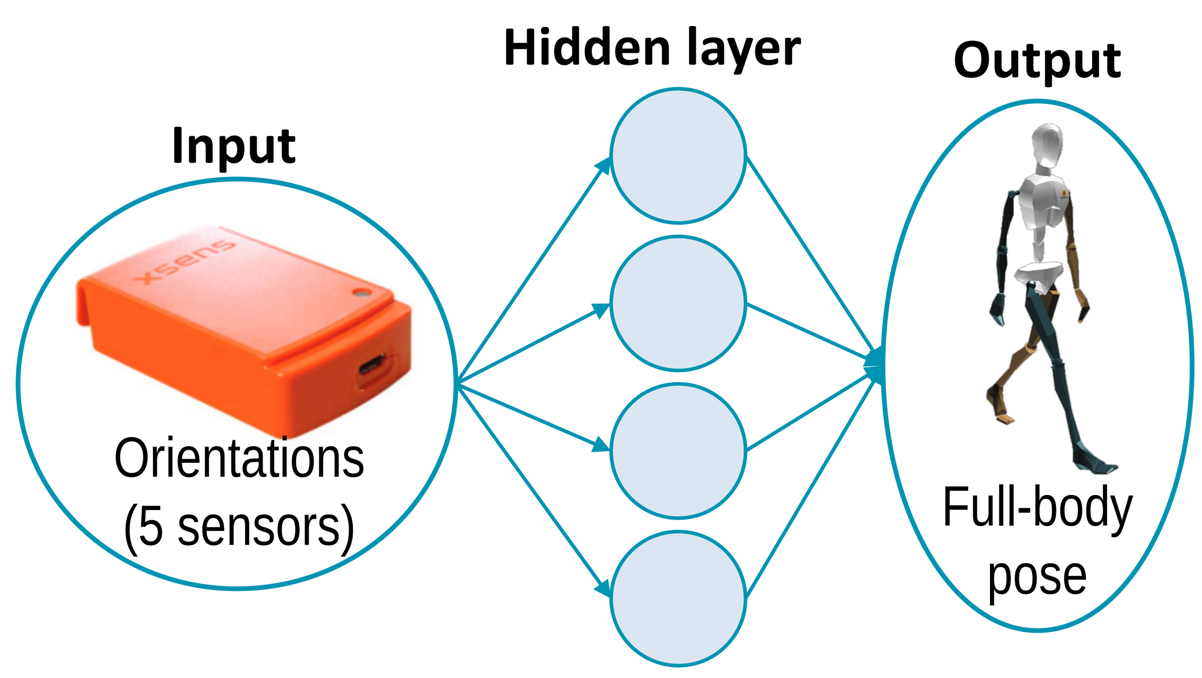

Figure 2: A schematic description of our method.

Results

Distribution of joint position errors[1] are similar for different subjects, thus proving good generalization (Figure 3).

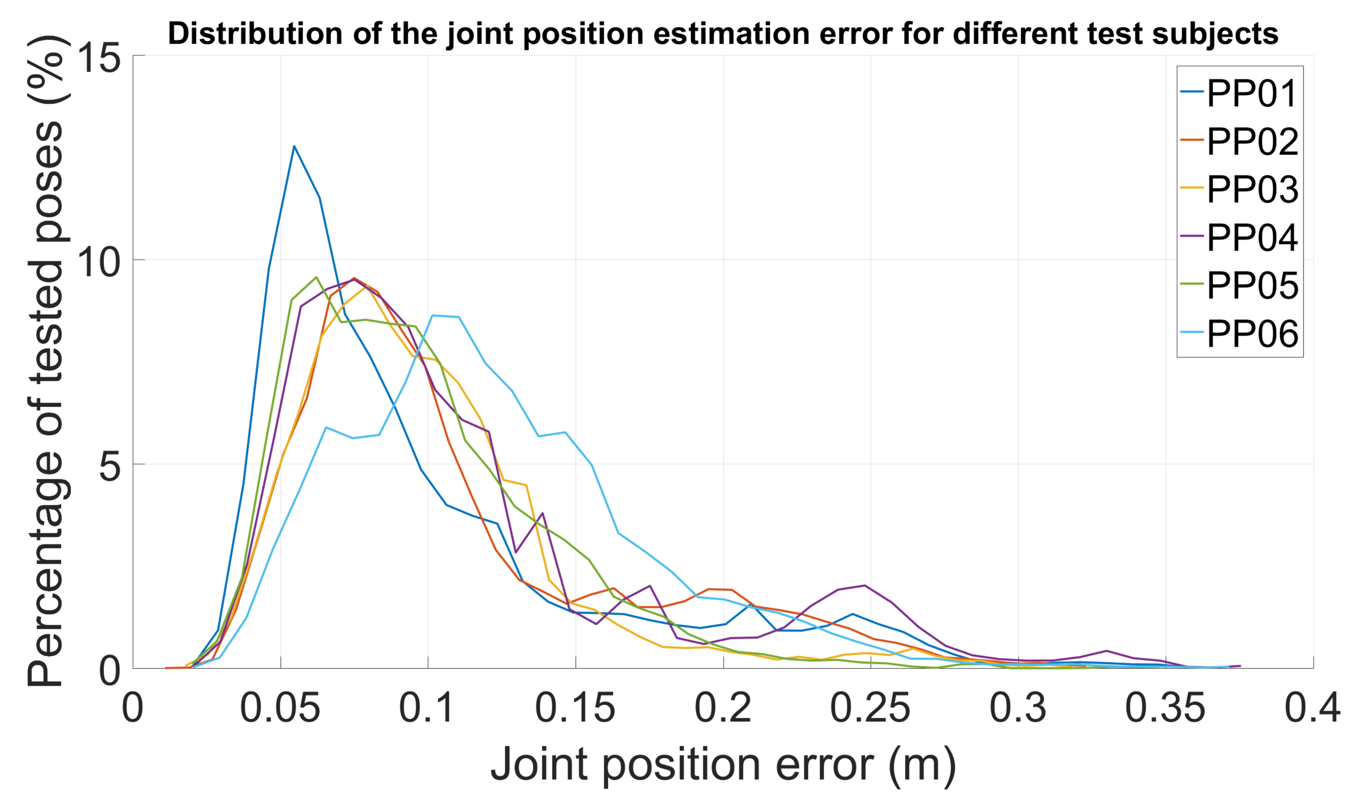

Figure 3: Distribution of joint position errors for the six tested subjects.

Different activities show diverging performance (Figure 4). For gait smallest errors are found, whereas errors increase for activities that involve more poses, such as ADL.

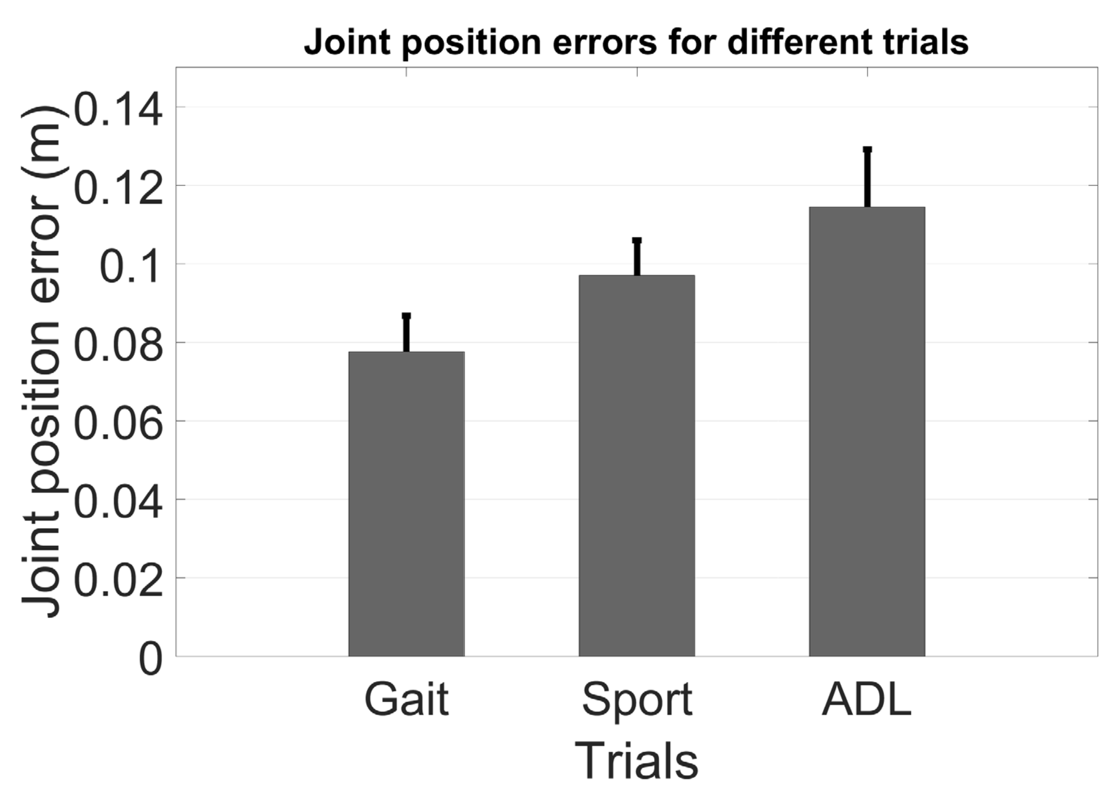

Figure 4: Bar plots of joint position errors (averaged over all subjects) for different activities.

[1] Joint position errors are calculated as the Euclidean distance between the joints of the measured and estimated pose.

Conclusion

Neural networks have shown to be suitable for estimating full-body poses using a minimal sensor set. This approach was shown to be capable of generalizing over different subjects. Better performance was obtained for estimation of poses in activities with less variety, such as gait.

<u>Future improvements:</u> Use temporal coherence to improve pose estimation over time.

These results are presented in a paper submitted on 30-09-2016 to the Body Worn Behavior Sensing special of Sensors.

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