Realistic sensor displacement benchmark dataset

Dataset Manual

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1. Introduction

This document briefly outlines the technical details of the fitness dataset for activity recognition. For more details please refer to the paper a "A benchmark dataset to evaluate sensor displacement in activity recognition" [1]. If you have any further questions please contact Oresti Baños (oresti@ugr.es) or Máté Attila Tóth (toth.attila.mate@gmail.com).

2. Sensor displacement scenarios

- Ideal-placement or default scenario: The sensors are positioned by the instructor to predefined locations within each body part. The data stemming from this scenario could be considered as the training set for supervised activity recognition systems.
- Self-placement scenario: The user is asked to position 3 sensors himself on the body part specified by the instructor. This scenario tries to simulate some of the variability that may occur in the day to day usage of an activity recognition system, involving wearable or self-attached sensors. Normally the self-placement will lead to on-body sensor setups that differ with respect to the ideal- placement. Nevertheless, this difference may be minimal if the subject places the sensor close to the ideal position.
- Mutual-displacement: An intentional de-positioning of sensors using rotations and translations with respect to the ideal placement is introduced by the instructor. One of the key interests of including this last scenario is to investigate how the performance of a certain method degrades as the system drifts far from the initial setup. The number of sensors displaced in this scenario increases from 4 to 7.

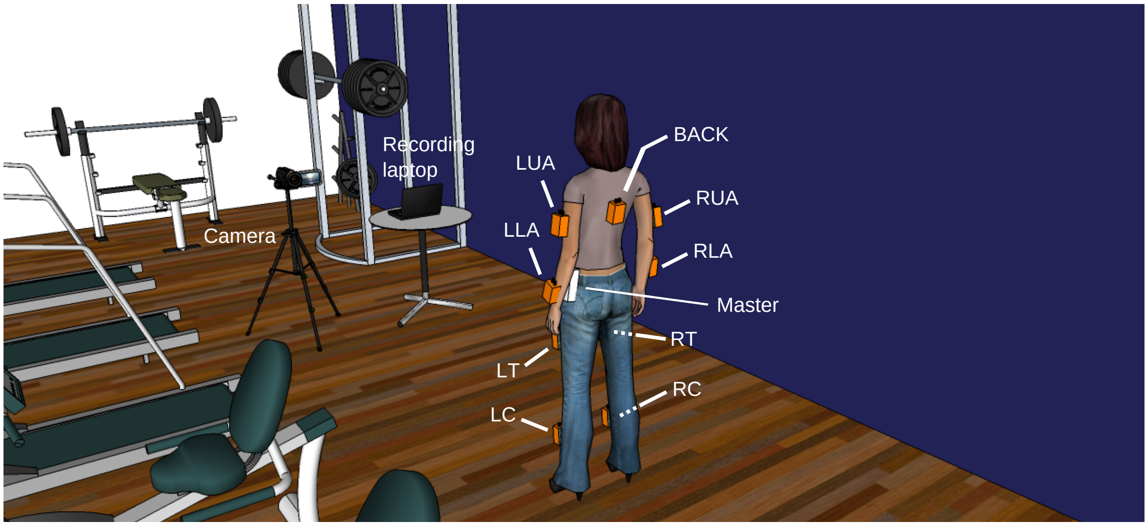

Figure 1: Experimental setup (cardio-fitness room). Eight Xsens units are placed on each body limb and an additional one on the back.

3. Sensors

9 Xsens inertial measurement units are distributed on the subject's body as shown in Figure 1. Each sensor node provides tri-directional acceleration, gyroscope and magnetic field measurements as well as orientation estimates in quaternion format (4D). Thus each sensor outputs 13 values at each measurement, which leads to an overall set of 117 recorded signals. The recordings were sampled at 50 Hz.

4. Activities

The dataset consists of a set of typical warm up, fitness and cool down exercises which are summarized in Table 3). We have included whole body (L1-L3), (L5-L8), (L31-33) as well as body part specific activities focused on the trunk (L9-L18), upper extremities (L19-L25) and lower extremities (L26-L29).

5. Log files

The filenames indicate the subject ID, the sensor displacement scenario, and in the case of mutual displacement the number of sensors displaced. The log files are structured as follows.The rows of the log file correspond to the consecutive samples of the mesurments

Sensor set
LC: Left calf
RC: Right calf
LT: Left thigh
RT: Right thigh
LLA: Left lower arm
RLA: Right lower arm
LUA: Left upper arm
RUA: Right upper arm
BACK: Back

Table 1: Warm up, cool down and fitness exercises considered for the activity set. In brackets the number of repetitions (Nx) or duration of the exercises (in minutes).

Activity set		
L1: Walking (1 min)	L12: Waist rotation (20x)	L23: Shoulders high amplitude rotation (20x)
L2: Jogging (1 min)	L13: Waist bends (reach foot with opposite hand) (20x)	L24: Shoulders low amplitude rotation (20x)
L3: Running (1 min)	L14: Reach heels backwards (20x)	L25: Arms inner rotation (20x)
L4: Jump up (20x)	L15: Lateral bend (10x to the left + 10x to the right)	L26: Knees (alternatively) to the breast (20x)
L5: Jump front & back (20x)	L16: Lateral bend arm up (10x to the left + 10x to the right)	L27: Heels (alternatively) to the backside (20x)
L6: Jump sideways (20x)	L17: Repetitive forward stretching (20x)	L28: Knees bending (crouching) (20x)
L7: Jump leg/arms open/closed (20x)	L18: Upper trunk and lower body opposite twist (20x)	L29: Knees (alternatively) bend forward (20x)
L8: Jump rope (20x)	L19: Arms lateral elevation (20x)	L30: Rotation on the knees (20x)
L9: Trunk twist (arms outstretched) (20x)	L20: Arms frontal elevation (20x)	L31: Rowing (1 min)
L10: Trunk twist (elbows bended) (20x)	L21: Frontal hand claps (20x)	L32: Elliptic bike (1 min)
L11: Waist bends forward (20x)	L22: Arms frontal crossing (20x)	L33: Cycling (1 min)

Table 2: Warm up, cool down and fitness exercises considered for the activity set. In brackets the number of repetitions (Nx) or duration of the exercises (in minutes).

sampled at 50 Hz. Each log file contains 120 columns. The first two columns of the samples correspond to the whole and rest part of the timestamp in seconds and microseconds respectively. The last column of the datafile corresponds to the activity label. The label is denoted by a positive integer corresponding to the activity in Table 3. Zero denotes that no activity label is present. The columns in between the 3rd and 119th column correspond to the sensor measurements. There are 9 sensors in total with 13 modalities each. The order in which the sensors and their respective modalities appear in the log file is detailed in Table 4 and 5 .

Activity set						
Timestamp (second)	Timestamp (microsecond)	RLA : ACC: X	RLA : ACC: Y	...	LC : QUAT : 4	Activity label

Table 3: The first to columns correspond to the timestamp while the last column corresponds to the activity label.

Sensor ordering									
	RLA	RUA	BACK	LUA	LLA	RC	RT	LT	LC

Table 4: The ordering of the sensors between the 3rd and 119th column. 13 columns correspond to each sensor.

Modality ordering									
	ACC : X	ACC : Y	ACC : Z	GYR : X	GYR : Y	GYR : Z	MAG : X	MAG : Y	MAG : Z
	QUAT : 1	QUAT : 2	QUAT : 3	QUAT : 4					

Table 5: The column order for any given sensor.

References

[1] Oresti Banos, Miguel Damas, Hctor Pomares, Ignacio Rojas, Mt Attila Toth, and Oliver Amft. A benchmark dataset to evaluate sensor displacement in activity recognition. In *Proceedings of the 2012 ACM Conference on Ubiquitous Computing*, UbiComp ’12, pages 1026–1035, New York, NY, USA, 2012. ACM.