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ACTIVITY RECOGNITION FOR PHYSICAL THERAPY MOVING TO THE HOME ENVIRONMENT

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1. INTRODUCTION

In physical therapy, the therapist is often interested in the functional capacity of the patient i.e. the ability to perform a certain task. Nowadays, this is assessed using a patient-reported (hence subjective) questionnaire such as the Bath Ankylosis Spondylitis Functional Index (BASFI) [2]. The questionnaire lists transitory activities used in therapy. Before or after performing the exercises in a therapy session, the patient scores his or her ability to perform it.

However, these activities are typically also performed in the home environment, even as part of daily life. As a first step towards the assessment of functional capacity at home, the relevant activities should be recognized. Secondly, they should be assessed objectively in an interpretable way, as an alternative to the current subjective evaluation. This work focuses on the first aspect.

Accelerometry has been used extensively for activity recognition [1]. Yet, it mostly focuses on recognition of repetitive activities or poses (e.g. walking, sitting), whereas the transitions are more informative in physical therapy.

2. MATERIALS AND METHODS

28 patients suffering from axial spondyloarthritis were equipped with a SenseWear Armband (2-axial accelerometer sampling at 32Hz). It was mounted at the upper (dominant) arm to capture both full-body and peripheral movement. Then, the patients performed a series of ten activities derived from the BASFI questionnaire, supervised by a physical therapist. The activities included e.g. sit-to-stand, maximal reach, getting up, lying down and picking up a pen (Figure 1).

Recognition of these activities is achieved through a two-step approach. In a first step, activity segments are segmented, discarding other parts of the continuous acceleration signals.

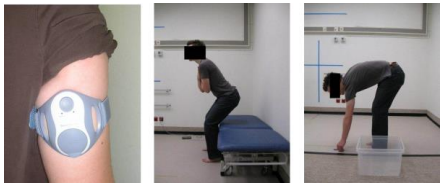


Figure 1: Sensor and example of activities

The second, actual recognition step compares and combines two approaches to classify segmented activities: *direct pattern matching* yielding similarities through Dynamic Time warping (DTW) and *statistical features*. Similarities and features are used as inputs in a Linear Discriminant classifier in a leave-one-subject out paradigm train-test setting.

3. RESULTS AND DISCUSSION

Combination of the DTW and statistical features yields significantly superior performance compared to each of them separately, with an average accuracy up to 93.6%.

These positive results pave the way for the next stage, the automatic and interpretable *assessment* of functional capacity, the subject of currently ongoing research.

References

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