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## Feature Fusion: H-ELM based Learned Features and Hand-Crafted Features for Human Activity Recognition

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### Abstract

Recognizing human activities is one of the main goals of human-centered intelligent systems. Smartphone sensors produce a continuous sequence of observations. These observations are noisy, unstructured and high dimensional. Therefore, efficient features have to be extracted in order to perform an accurate classification. This paper proposes a combination of Hierarchical and kernel Extreme Learning Machine (HK-ELM) methods to learn features and map them to specific classes in a short time. Moreover, a feature fusion approach is proposed to combine H-ELM based learned features with hand-crafted ones. Our proposed method was found to outperform state-of-the-art in terms of accuracy and training time. It gives an accuracy of 97.62% and takes 3.4 seconds as a training time by using a normal Central Processing Unit (CPU).

### Keywords

**Author Keywords:** Hierarchical extreme learning machine; kernel extreme learning machine; deep learning; feature learning; human activity recognition; feature fusion

**KeyWords Plus:** MACHINE

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