
Master thesis : Prediction of the absolute and relative intensity of daily life activities

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Faculté : Faculté des Sciences appliquées

Diplôme : Master en ingénieur civil biomédical, à finalité spécialisée

Année académique : 2024-2025

URI/URL : <http://hdl.handle.net/2268.2/24791>

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Prediction of the absolute and relative intensity of daily life activities

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Academic year 2024-2025

Physical activity plays a fundamental role in health, contributing to the prevention of chronic diseases and the promotion of overall well-being. Despite its benefits, a significant portion of the population remains inactive, highlighting the need for accurate and individualized methods to assess physical activity intensity. Intensity, which influences health outcomes, can be measured in absolute terms or in relative terms. While absolute intensity is independent of an individual's fitness level, relative intensity offers a more individualized perspective, which is important for personalized assessment of physical activity.

This study explores the feasibility of classifying relative intensity using wearable inertial sensors combined with machine learning techniques, and compares its performance with absolute intensity classification. Data were collected from twenty participants performing seven daily activities, using inertial measurement units placed on the wrist and the foot to record movements. After data segmentation, feature extraction, and the construction of the final datasets, three supervised machine learning models including Random Forest, Support Vector Machine, and Multilayer Perceptron, were developed and evaluated. Both multiclass (sedentary, light, moderate and vigorous) and binary (sedentary-light vs. moderate-vigorous) classification were explored to assess model performance across different tasks and sensor placements. A feature importance analysis was also conducted to identify the most discriminative features in the classification of relative intensity using the wrist sensor.

The results indicated that classifying relative intensity from inertial sensor data remains challenging. Multiclass classification often resulted in confusion between intensity levels, whereas binary classification improved overall performance. Sensor placement affected model outcomes, with performance varying across algorithms and tasks. Absolute intensity classification achieved higher overall performance in both multiclass and binary tasks and for both sensor placements, although some confusion still occurred. These results show that absolute intensity is generally easier to classify than relative intensity, which reflects the additional complexity of personalizing intensity assessments. Among the tested models, Random Forest consistently achieved the highest performance across all tasks and sensor placements.

These findings provide insight into the challenges of using wearable sensors and machine learning to assess the relative intensity of physical activity.