

WEARABLE TECHNOLOGIES ARE GROWING FAST BUT SO ARE THE ANALYTICAL CHALLENGES

Evidence from the Analytical Approaches Developed for the Northern Finland Birth Cohort Study 1966



Is machine learning the solution to precisely measure physical activity behaviors?

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The tremendous advancement of sensor and wearable technologies in the last few decades has now enabled continuous measurement of daily activities over longer periods of time (e.g. few weeks). This has accordingly provided an opportunity for the data scientists to track daily activities and their patterns to understand how they are related to health. To this aim, the first key step is precise measurement of daily activities from motion signals measured by wearable monitors; the more precise measurement of physical activity behaviors, the better understanding of their influence on health. This could, however, be very challenging mainly because motion signals are complex in nature and the amount of produced data is increasing. Therefore, more complex analytical approaches are needed.

We have now entered the machine learning era. The advanced machine learning approaches have emerged in a variety of fields including measurement of physical activity behavior, mainly to overcome the limitations of traditional statistical approaches. Review of the existing literature (62 studies from more than 2500 identified research articles) revealed that machine learning techniques have enabled more precise measurement of physical activity behavior from signals measured by wearable activity monitors.

Accordingly, we selected, tested and validated a robust machine learning-based model suitable for analyzing the activity monitor data collected from the large Northern Finland Birth Cohort 1966 study. The experimental study showed that even though machine learning approaches are known to be a proper solution to this particular problem, further strategies are needed to facilitate their performance to predict physical activity robustly with over 80% accuracy; the required accuracy level to better understand the relationships between daily activity, their patterns, and health.

Summary of research articles:

Farrahi V, Niemelä M, Kangas M, Korpelainen R, Jämsä T (2018). Calibration and validation of accelerometer-based activity monitors: A systematic review of machine-learning approaches. *Gait & Posture*. <https://doi.org/10.1016/j.gaitpost.2018.12.003>

Farrahi V, Niemelä M, Tjurin P, Kangas M, Korpelainen R, Jämsä T (2019). Evaluating and enhancing the generalization performance of machine learning models for physical activity intensity prediction from raw acceleration data. *IEEE Journal of Biomedical and Health Informatics*. <https://doi.org/10.1109/JBHI.2019.2917565>

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WHAT IS THE BENEFIT OF MACHINE LEARNING APPROACHES FOR THE NORTHERN FINLAND BIRTH COHORT 1966 STUDY?

It enables data accuracy, and subsequently opportunities for updating the recommendations and guidelines for public health in future studies.