Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4634** Type: **Poster Competition (Graduate Student) / Compétition affiches (Étudiant(e) 2e ou 3e cycle)**

(G*) (POS-48) Using Machine Learning to Identify Motion Patterns from Acceleration and Angular Velocity Readings

Tuesday, May 28, 2024 6:37 PM (2 minutes)

Clinicians typically rely on self-reporting outcomes to assess an arthritis treatment's efficacy, leaving reported data subject to bias. Thus, there is need for devices that can measure and record patients' daily activity to help assess patient recovery. Inertial measurement units (IMUs) combine an accelerometer and gyroscope to quantitatively measure physical motion; machine learning (ML) algorithms are well-suited to perform detailed time series analysis of the IMU data to identify specific patient activities. The objective of this study is to verify if the LSM6DSOX IMU, which contains a Machine Learning Core (MLC), can classify activities in real-time based on the 3D motion data from the IMU.

Training data was acquired from 5 participants using a single IMU attached at the base of each participant's spine; the IMU measured 3 accelerations (in Gs) and 3 angular velocities (in degrees/s). Data was collected as the participants performed a series of activities and was then segmented and labelled based on activity type. The MLC is a binary decision tree model that uses a sliding window approach to contextualize sequences of consecutive time-series data. Scalar features are extracted from each data window to provide representative inputs to the classification model. Theses features had to be manually selected to help differentiate between the target activities using knowledge of the unique patterns produced in the data from different motions. After training, the model's accuracy was checked on the test set.

Making predictions on the test set resulted in a test accuracy of 96% and precision scores of: 99% for stationary motion, 100% for walking, and 86% for running. The results demonstrate that a single IMU with built in MLC can effectively analyze and identify patterns in complex 3D motion time series data to correctly classify various physical activities. Using edge AI allows for low power operation, minimizes storage demands, and maximizes privacy making it ideal for long-term remote applications. This work could lead to a low-cost motion data acquisition system that provides objective activity data that could significantly improve the assessment of therapies for musculoskeletal conditions, like arthritis.

Keyword-1

Machine Learning

Keyword-2

Motion Recognition

Keyword-3

Primary author: WILSON, Kyle

Co-authors: HOLDSWORTH, David (Western University); POLLMANN, Steven (Western University)

Presenter: WILSON, Kyle

Session Classification: DPMB Poster Session & Student Poster Competition (28) | Session d'affiches DPMB et concours d'affiches étudiantes (28)

Track Classification: Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)