**Abstract**

In recent years, recurrent neural networks have shown great promise in being able to learn from sequential-based biomedical data and, in particular, data representing different human movement behaviours with corresponding classifications or regression scores associated with degrees of severity of the movement-based condition. Duchenne muscular dystrophy (DMD) is one such condition, which primarily affects young males and a range of their movements including walking, standing upright, and getting up from the floor, and progressively worsens over time. To measure the severity of the condition in a subject, the North Star Ambulatory Assessment is often used to assess the subject on 17 basic activities, with a score of 0, 1, or 2 for each activity obtained based on the ability for the subject to perform each activity. As part of a wider research initiative within the Brain and Behaviour Lab at Imperial College London and in collaboration with Great Ormond Street Hospital to study the application of AI technologies to help with breakthroughs in DMD research, data is captured via the Xsens MVN body suit system of multiple subjects undertaking the NSAA assessments, along with a 6-minute walk assessment and multiple natural movement behaviours, with corresponding NSAA scores recorded at the hospital by assessors.

Using this movement data and the associated NSAA scores for the subjects, we have built a complete system that extracts a variety of different measurements from the source data files, computes statistical values from these, divides the data into sequences, and trains models using both raw measurements and the statistical values as a measurement, along with supplementary scripts to help with data analysis and individual file assessments on pre-built models. Extensive experimentation was then done to find the optimal setups for the models, with different measurement combinations, sequence extraction techniques, and other preprocessing steps considered. We also explored different adaptations of the system, from the assessment of new subjects in the initiative in order to predict their corresponding scores, to new assessments of existing subjects in order to evaluate the progress of their condition over time. In doing so, we have managed to draw numerous insights into the nature of DMD-based movement data, from the most significant measurements to draw from the suit data to the time-context window needed to capture many of the activities ideally, along with finding the best system setup to generalise towards the assessment new and existing subjects, which eventually lead to a wrapper script for the system that would aid specialists in assessing of subjects through the use of an AI-based tool.

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