

A weightlifting clean and jerk team formation model by considering barbell trajectory and LSTM neural network

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Clean and jerk is one category of Olympic weightlifting. The barbell trajectories including much kinematic parameters such as moving distance, velocity and acceleration provides coaches and athletes to indicate their sport performance. As can be seen in Figure 1, we can obtain that the performance of this lift is well done. However, trajectory need exports or sport scientists to read and further translate to coaches and athletes. In this paper, we want to utilize a neural network architecture to indicate the performance of the weightlifting lifters.

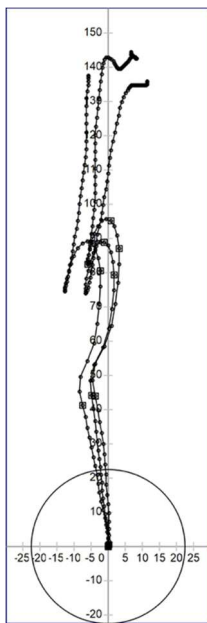


Figure 1 Trajectories of three continuous attempts

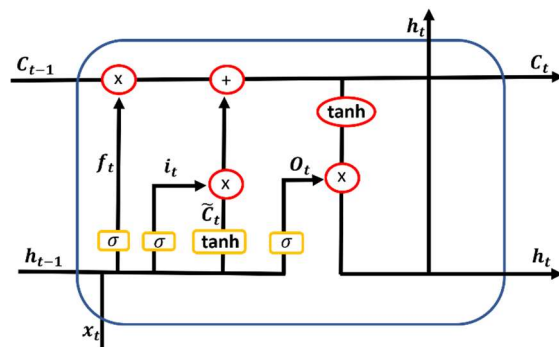


Figure 2 long-short-term memory (LSTM) structure

Considering barbell trajectory characteristics, the all moments movement was interdependent, time-sequential, long-short-term memory (LSTM) (Shown in Figure 2) architecture is utilized in this paper.

Also can be seen in Figure 1, solid nodes are the barbell spatial position and further projecting into one frame, between node and node, it denotes the displacement of the barbell in temporal. Thus, we use the relation between these nodes as the feature vectors and training the LSTM architecture. From relevant researches of Clean&Jerk, scholars obtain many kinematics parameters which can efficiency indicate the performance of the lifter. We select horizontal displacement, vertical displacement, moving distance, duration and vertical speed[1]-[4]. Furthermore, for efficiency reducing the data dimension, we separate a Clean&Jerk barbell trajectory into 11 phases[5]. These phases are first pull, transition, second pull, turn over, catch bar, clean recovery, jerk set position, jerk dip, jerk drive, and, supported split under the bar, jerk recovery. Above parameters in each phases will be gathered and calculated and further composed as the feature vectors.

We gather the domestic adult competitions from 2019 to 2021 in Taiwan and utilize video tracking scheme to obtain the barbell trajectory from Clean&Jerk competitions. 61Kg, 67Kg, 73Kg, 81Kg, 89Kg and 96Kg man categories are selected as our training, validation and testing samples. From the results, our inference model highly accuracy identify the performance of Clean&Jerk of the lifter. This model show that the lifter who is excellent will maintain fixed movement technique and high stability also have low variability such as the traditional research's result in kinematic analysis of Clean&Jerk. In sports biomechanical this model which develop in this research could help decide the lifter technical movements by accurate trajectories change can judge. Coaches can team formation by considering our architecture to obtain the excellent lifter.

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