

# Analysis of karate technic *mae-geri* using cinematographic method and OpenSim software

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## 1. Introduction

The objective of this bachelor thesis is an analysis of karate *mae-geri* kick, an identification of both motion's phases and the most active muscles, as well as a measurement of an increase in total energy of punching bag, in which the subject of the study has kicked. Additionally, a comparative analysis of the kicks between male and female was conducted, including dominant and non-dominant legs. To achieve that 10 measurements for each case were recorded.

The measurement was conducted in Centralny Instytut Ochrony Pracy (Central Institute for Labour Protection), in Warsaw, using QTM Qualisys system where it was recorded as .C3D data. During further analysis OpenSim software was used.

## 2. Results

Firstly, phases of kick were identified: rising of lower leg to reach 90 degree in knee joint, rising leg with still degree in knee joint, the kick and returning to starting position. Timeline below illustrates the kick and shows moments where distinguish values were obtained.

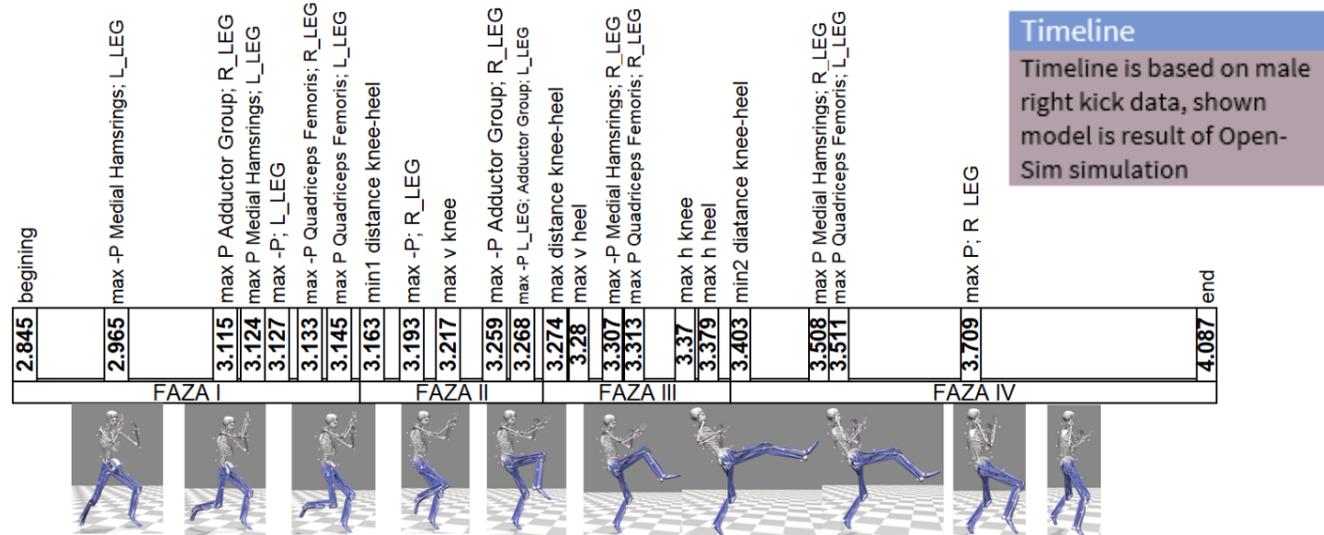


Figure 1: Main features of *mae-geri* kick – timeline

Secondly, technical correctness was checked. The criterium was M. Nakayama's book – "Dynamic Karate", analysis was conducted using cinematographic method (ex. Is foot touching ground during movement) and using data derived from Inverse Kinematics (ex. degree in knee joint). Both, female and male, have excellent level of technical correctness, yet females' performance was slightly better.

Afterwards, punching bag energy was calculated and comparative analysis were conducted. Bag energy was analysed in small span of time, just after contact with the leg of sportsman/ sports-woman. Using this assumption, bag was treated as cylinder, rotating around the axis on its top.

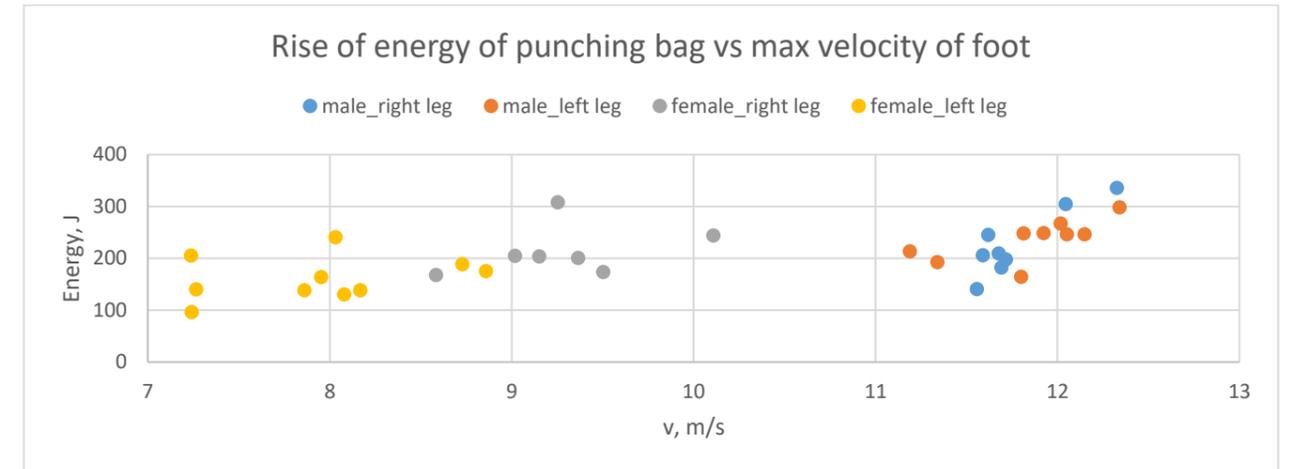


Figure 2: Rise of energy of punching bag vs max velocity of foot – comparison between measurements

Figure 2 illustrates dependence between max foot velocity and increase of energy of punching bag, useful to illustrate repetitiveness of fighters' kicks and discrepancy between dominant and non-dominant legs. Both sportsmen claim that their dominant leg is right.

## 3. Conclusions

- Model, which was used during analysis, can be considered as correct. Maximal power of muscles obtained from it are similar to results from Instytut Sportu (Sport Institute) in Warsaw.
- The highest muscles' power was noticed, in kicking leg, during phase 3.
- Males' kick energy was almost twice higher it was also more repetitive, furthermore, asymmetry wasn't noticed.
- Visible asymmetry between woman kicks, right leg is dominant. Lack of repetitiveness.
- Lack of considerable discrepancy of bag energy between sportsmen can be result of heavy rack supporting bag. Probably it was accumulating major part of fighters' kicks during recording.
- To improve accuracy of study and results, force sensor should be placed on punching bag. It would enabled to add external load to OpenSim model and obtain for example forces in fighters joints.