



ÓBUDAI EGYETEM  
ÓBUDA UNIVERSITY

## REVIEW and EVALUATION

of the Doctoral Thesis and Dissertation

### BIOMECHANICAL IMPACT OF RUNNING-INDUCED FATIGUE ON LOWER LIMB ASYMMETRY IN RUNNER

(by Zixiang Gao)

The candidate has corrected his PhD work based on my recommendations. I accept his corrections.

#### NOVELTY OF THE TOPIC

In the candidate's doctoral work, he examines locomotor injuries caused by long-distance running. The frequency of musculoskeletal injuries caused by running is increasing, especially in the lower limbs of amateur runners. Fatigue-induced changes in the symmetry of the lower limbs are possible due to unilateral limb overload.

The thesis deals in detail with the bilateral plantar pressure distribution, which is related to tired walking. Methods based on deep learning algorithms used in practice represent progress, but do not give satisfactory results. The candidate further examines the bilateral plantar pressure data for the early detection of tired walking. Its purpose is to recognize fatigue in the early stages of running. During his tests, he takes into account the distribution of the plantar force of the dominant and non-dominant foot.

Another research part of the thesis is the effect of long-distance running on gait symmetry. How does symmetry change during running in different stages of long-distance running. For this, he uses different theories and statical calculations to better understand the biomechanics and functioning of walking.

Previous research did not really deal with the distribution of the load on the knee joint or its extent. The candidate examines the differences between the generated tensions and analyses the various joint loads.

#### STRUCTURE OF THE DISSERTATION

The dissertation is in line with the requirements of the PhD school. The chapters are well-structured and follow each other logically. The dissertation consists of 5 chapters (110 pages), in which the candidate refers to 230 publications closely related to the topic. Sometimes there are typos and wording inaccuracies.

The dissertation begins with the justification of the choice of topic and formulation of goals. A kind of summary to help the reader. To support this, numerous publications present and draw

attention to it. The first chapter deals with a detailed presentation of this. The second chapter is Material and Method. In this chapter, the subject of the tests, the observation criteria, the presentation of the experimental environment and the applied theories and methods are described. MRI equipment is used to record the magnetic resonance data and the plantar force data of the foot is stitched together longitudinally to obtain the force distribution information. It sets up an optimal convolutional neural network model for the recognition of tired walking by error checking the parameters.

In the third chapter, the numbering of the figures and the text part are not related please correct this. The tests performed are therefore difficult to follow, I am thinking here of the detection of plantar pressure and tired walking or the exertion of force in different parts of the foot.

The fourth chapter described the obtained results in detail. It examines the effectiveness of the applied models. The results showed that the fatigue of running changed the distribution pattern of the plantar load of the dominant and non-dominant limb. The results of the dynamic stability test contribute to the evaluation of risk factors related to injuries and help in the early recognition of tired walking.

#### NEW SCIENTIFIC RESULTS

I accept the first thesis, second thesis and third thesis too.

#### FINAL CONCLUSIONS

I suggest that the candidate should obtain his PhD degree.

19/06/2024, Budapest



Ildikó Molnár PH.D