AI based analysis of human motor skills

Summary

TalTech School of Information Technologies, Department of Software Sciences offers a 4- year PhD position in the field of ICT.

Research field:	Information and communication technology
Supervisors:	Dr. Sven Nõmm Aaro Toomela
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Software Science
Application deadline:	Applications are accepted between September 01, 2020 00:00 and October 02, 2020 23:59 (Europe/Zurich)

Description

Background and motivation

Motor skills are important determiners of quality of life and also correlates of cognitive performance and cognitive development. Until recently motor skills were estimated outside laboratory conditions either subjectively by relevant professionals (medical doctors, teachers, psychologists) or measured by tests where the criterions of the level of motor skills were time needed to perform the test and/or the number of correctly performed motor acts (such as putting small pegs in holes). Recent developments in recording movement by different devices allow to measure objectively not only time and success rate but also characteristics of movements themselves [1].

Main objective and research methods

The objective of the thesis is to develop AI based motion skill assessment framework. Advanced methods of the AI and machine learning will be used on two levels. On the lower level AI and machine learning techniques will be applied to the movements recorded by different devices (Motion capture systems, video cameras, tablet PC) to extract accurate models of human body [2]. In order to unlock the full potential of the advanced techniques of the machine learning and artificial intelligence, development of the novel objective measures of gross and fine motor skills is required. Novel characteristics of the movement are going to be tested in different groups of individuals (adults with different levels of educations; elderly and young adults; school-children at different ages; individuals with different forms of brain damage). Relationships between objective measures of fine and gross motor skills and different aspects of cognitive performance and cognitive development are going to be studied in order to understand better the role of motor skills in cognitive performance and cognitive development. On this higher level, this will lead to explosive growth of complexity which will be tackled by most recent AI techniques for data analysis.

Research methods

The methods of AI will be applied on two different levels. On the level of motion capture and initial processing deep neural-networks to provide higher quality models of human body. On the higher level, where relationships between cognitive development and motor skills will be studied in different groups AI techniques for big data analysis will be employed.

Expected impact

Improvements in objective description of gross and fine motor skills facilitates diagnosis of cognitive dysfunction, neurological conditions and developmental disorders. It also supports objective follow-up of the effectiveness of re-habilitation as well as better planning of rehabilitation and special education activities.

Candidate's Background and Knowledge

- The candidate is expected to have solid knowledge of mathematics and statistics
- Completed master level courses in machine learning and data mining
- Basic understanding of deep learning techniques
- Possess skills in software development
- Good knowledge of Python is preferable

References

[1] Prakash, C., Kumar, R. & Mittal, N. Artif Intell Rev (2018), Recent developments in human gait research: parameters, approaches, applications, machine learning techniques, datasets and challenges 49: 1. https://doi.org/10.1007/s10462-016-9514-6.
[2] Zhao, C.; Chen, M.; Zhao, J.; Wang, Q.; Shen, Y. 3D Behavior Recognition Based on Multi-Modal Deep Space-Time Learning. Appl. Sci. 2019, 9, 716.
[3] Toomela A, Nõmm S, Kõnnussaar T and Tammik V (2019) Why Behavioral Indicators May Fail to Reveal Mental States: Individual Differences in Arousal-Movement Pattern Relationships. Front. Psychol. 10:270. doi: 10.3389/fpsyg.2019.00270