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HABILITATION THESIS REVIEWER'S REPORT

Masaryk University	
Applicant	RNDr. Jan Sedmidubský, Ph.D.
Habilitation thesis	Content-Based Processing of Human Motion Data
Reviewer	**Assoc. Prof. Dr. Klaus Schöffmann**
Reviewer's home unit, institution	Alpen-Adria-Universität Klagenfurt

The thesis of RNDr. Jan Sedmidubský focuses on human motion data processing for automatic detection and recognition of actions in human motion and content-based subsequence search. This highly relevant research problem poses many challenges, such as unique motion processing, action modeling, semantic content classification, similarity search, content indexing, and even more. It is also a practically challenging problem. It deals with unstructured data that can be imprecise and voluminous, significantly affecting the effectivity and efficiency of similarity search and indexing when not performed appropriately.

Dr. Sedmidubský has dedicated his year-long research to this exciting topic and proposed several novel methods that provide significant contributions to fundamental research questions in this field. In particular, he has performed substantial research on the topic of 3D human skeleton processing and published a significant amount of papers in the areas of (i) metric learning, (ii) gait recognition, (iii) action recognition, (iv) subsequence search, and (v) action detection. The research works of Jan Sedmidubský propose novel methodologies for effective and efficient processing of motion data, to be used content analysis and content-based search/retrieval. The papers deal with basic research questions in these fields, such as:

- How can we model/encode the motion of skeletons in a 2D and 3D manner?
- How can we visualize skeleton motion?
- How can we effectively measure the similarity of motion patterns and actions?
- How can we efficiently index skeleton motion and search for similar motion scenes?
- How can we classify motion data with state-of-the-art deep learning methods?
- How can we efficiently evaluate the achievable performance of motion/action recognition?
- How can we retrieve subsequences of motion patterns and match them?
- How can we label motion data in real-time?

Dr. Sedmidubský has also developed public demonstration systems for his motion processing methods, available online, which show how well the proposed methods work. Accepted tutorials at renowned conferences (e.g., ACM Multimedia and ACM ICMR) further show that the addressed research topic of human motion data processing is timely and highly relevant in the domain of informatics. Also, the Google Scholar research profile of Jan Sedmidubský shows that he is a highly active researcher. He regularly publishes relevant work in high-class venues, with an increasing upwards trend of citations. Furthermore, he is an international research scholar who has collaborated in several international research and educational projects.

In total, Jan Sedmidubský has co-authored 21 conference papers and six journal papers just for the topic of human motion data processing, several of which were also awarded (e.g., as Best Student Paper, or with the Dean's, Rector's, and IBM SUR Award). These works were published in high-class venues, such as Springer's *Multimedia Tools and Applications* (MTAP), Springer's *Multimedia Systems* (MMSJ), the *European Conference on Information Retrieval* (ECIR), Elsevier's *Information Systems*, the *International Conference on Database and Expert Systems Applications* (DEXA), the *International Conference on Advanced Concepts for Intelligent Vision Systems* (ACIVS), the *European Conference on Advances in Databases and Information Systems*, and the *International Symposium on Multimedia* (ISM).

Jan Sedmidubský is an outstanding researcher who – together with his team – is performing state-of-the-art research and has published several novel works for the field of human motion data processing. It is essential to mention that these works are not limited to this domain, however. They can also be applied to several other disciplines – for example, to the medical field of minimally-invasive surgery, where these days, most of the interventions are recorded and archived for later search (e.g., for teaching purposes, or skill rating/assessment). Similarly, there is a strong demand for motion data processing in various sports domains (e.g., analyzing, comparing, and optimizing actions/movements of professional athletes).

Finally, Dr. Sedmidubský is an experienced university teacher who has taught several lectures and laboratory courses for many years. Moreover, he has supervised numerous Bachelor theses and Master theses and led the research for several doctoral candidates, who published excellent research papers under his supervision. He has also served as a member in several administrative duties, such as state examination boards, doctoral boards, and doctoral committees.

Reviewer's questions for the habilitation thesis defense (number of questions up to the reviewer)

- What is the most important contribution proposed in your habilitation thesis?
- In the context of human motion data processing, do you think Dynamic Time Warping (DTW) is outdated and should no longer be used in research for this field, or are there still some application areas for this technique?
- What are the benefits and downsides of using Bi-LSTM for action classification in motion data, and are there better alternatives?
- Do you think GRU (Gated Recurrent Units) would work better/worse for motion data processing than Bi-LSTM, and did you experiment with GRU already?
- What are the most challenging future directions (or research questions) to be addressed for the field of human motion data processing?
- Do you know other fields (outside of human motion data processing) where the methods proposed in your habilitation thesis can be applied?
- Assumed you get funding for another research project (as a PI) that employs two doctoral candidates, which research topics would you suggest to them to pursue in their doctoral career for the next few years?

Conclusion

The habilitation thesis entitled "Content-Based Processing of Human Motion Data" by RNDr. Jan Sedmidubský, Ph.D., **fulfills** the requirements expected of a habilitation thesis in the field of Informatics.

Date: 24.09.2021   Signature: