Evaluation report for ŠTĚPÁN MRÁČEK

The PhD thesis of Štěpán Mráček consist of 7 chapters and 1 appendix and the title of the thesis is “Hybrid 3D face recognition”. In the remainder of this evaluation report I will give a brief description and comment on each of the chapters in the thesis.

1 Publications
The candidate has published 8 papers, 7 of which as a first/only author and the last one as second author. Two of the papers are published in the highly recognized “International Conference of the Biometrics Special Interest Group (BIOSIG)”. Of the remaining papers 1 is published at SPIE Defense and Security, 1 as a book chapter in “New Trends and Developments in Biometrics” and 2 at other IEEE related conferences. The topics of all publications are related to the topic of the PhD thesis of Štěpán Mráček.

2 Other activities
Štěpán Mráček has been involved in various projects in different roles. In two of the projects he has had the role of team leader. Furthermore he was involved in the supervision of 6 BcT and 5 MsT theses as well as reviewing 5 BcT and 1 MsT theses.

3 Thesis evaluation
3.1 Chapter 1: Introduction
This chapter contains only 1 page and briefly introduces the topic of the dissertation and gives an overview of what can be found in the remaining chapters.

3.2 Chapter 2: Biometrics
In this 7 page chapter the basics of biometrics are described to the reader. Terminology is defined in a logical order. The chapter concludes with a description of possible fusion methods which is highly relevant as the topic of the thesis is related to fusion.
3.3 Chapter 3: Obtaining Three Dimensional Data
In this 6 page chapter the reader learns about 3D face data, how it can be obtained and what commercial sensors can be found. The explanation of the structured light method on page 12 is a bit unsatisfactory. In the last step it is only mentioned “Calculate the depth information from the shift between the observed stripes and the original stripes” without giving an explanation of how (and why) this works. An example would have been nice here.
The chapter concludes with an overview of available 2D and 3D databases. From the overview it is clear that 3D face recognition has not been researched as thorough as the 2D version, and that more research (and more publicly available databases) are highly needed.

3.4 Chapter 4: Overview of Face Recognition Techniques
This is the longest chapter (27 pages) and gives a very good overview of the state of the art in face recognition, both for 2D and 3D. Some of the sections in this chapter are very short and could maybe have been combined. In Section 4.4 various (general) recognition techniques that are often used in face recognition are described in detail. Sometimes the writing has some small errors, which are easy to spot, e.g. Equation 4.4, where “Mx” should be “Mv” and below Equations 4.16 and 4.17 where class $C_k$ is renamed to class $X_k$.
The setup of the chapter is logical, starting off with general information and 2D face recognition techniques and ending with a description of 3D face recognition methods.

3.5 Chapter 5: Proposal of the Recognition Algorithm
In this chapter the candidate propose his own scheme for 3D face recognition. The steps followed in this chapter (as shown in Figure 5.1) are logical for 3D face recognition. The description in Section 5.2.1 is not entirely clear. It states that “If not converged, return to 3”, while not giving criteria to determine convergence. Additionally the description in Section 5.7.3 seems rather strange. In the last step, the best unit is selected and added to the set $S$, only then followed by checking if this addition improved the results or not. This means that the last addition to $S$ before exiting the procedure always adds a unit that does not improve the performance. Most likely there was first a check to see if the best unit would give improvement and if so, adding it and continuing the procedure, otherwise exiting.
A final comment is about Sections 5.7.1 and 5.7.2. According to the information in Section 5.7.1 are many score normalizations possible, and in fact 6 are described. At the start of Section 5.7.2 we read that only the normalization from Equation 5.9 is used, without explaining why the other 5 have been described or why this particular one is chosen.

3.6 Chapter 6: Evaluation
Chapter 6 presents 22 pages of results obtained in hybrid 3D face recognition. Results are presented for an impressive number of different ways of analyzing data. Results are mostly presented in terms of EER for various settings, like different distance metrics, different sizes of ROI, etc. Resulting EER values are often very close together and no confidence intervals are given, hence it is not possible to determine the optimal choice for a parameter. Furthermore are many setting chosen independent of each other, but when looking at Table 6.5
we can clearly see that there is dependency. For example if first Euclidean Metric was used to
determine which projection method would perform best, then PCA or Fisherface would clearly
be chosen. However the combination ICA or PCA+z-score and Correlation or Cosine Metric give
much better results. PCA parameters (Section 6.3.1) and Region of Interest (Section 6.3.2) are
however chosen completely independent. So in principle there is no guarantee that the final
selection of settings is the true optimal choice.
Besides a thorough analysis of the methods of the candidate does this chapter also contain a
section on the limitations of face recognition. Researchers are often overly optimistic about “their
own” biometric modality, so it is good to see a reflection on the limitations included.

3.7 Chapter 7: Conclusion
This chapter gives a short conclusion on the results described in the dissertation and links it to
the publications of the candidate. A number of challenges are described, like facial expressions,
head rotation, lighting conditions and wearing glasses. It would have been nicer to really describe
these as future research and indicating how such challenges could be addressed in future
research.

4 Conclusions
Given the above evaluation of the dissertation, publication, and other activities of the candidate
Štěpán Mráček, I believe that in my expert opinion, the requirements of the proceedings leading
to PhD title conferment are fully met.

Best Regards,

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