

## Jury Member Report - Doctor of Philosophy thesis.

**Name of Candidate:** Evgeniya Ustinova

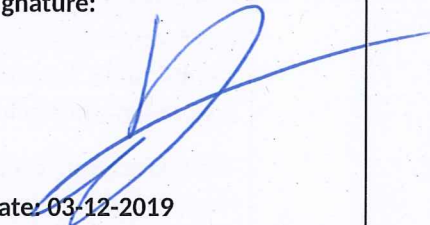
**PhD Program:** Computational and Data Science and Engineering

**Title of Thesis:** Image-based Human Re-identification and Recognition Using Deep Learning Methods

**Supervisor:** Prof. Victor Lempitsky

**Date of Thesis Defense:** 11 December 2019

**Name of the Reviewer:** Dr. Radu Timofte

<p>I confirm the absence of any conflict of interest</p> <p>(Alternatively, Reviewer can formulate a possible conflict)</p>	<p><b>Signature:</b></p>  <p><b>Date:</b> 03-12-2019</p>
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*The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.*

*If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.*

### Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The thesis written by Evgeniya Ustinova addresses two important human recognition problems: person re-identification and face recognition. It describes algorithmic contributions and results of convolutional networks (ConvNets) with application to person re-identification and face recognition, respectively. The core chapters of the thesis are based on published peer-reviewed papers at top computer vision and machine learning venues and follow a logical order.

*The abstract* succinctly provides an overview of the contents and the research topics approached in the PhD thesis. First, an introductory chapter and a related rework chapter provide the necessary motivation and background. Then, the main contributions are introduced in detail in the subsequent four chapters and, finally, the conclusions are drawn in the final chapter. The main topics and the corresponding contributions follow the chapter organization of the thesis: i) learning deep embeddings with histogram loss; ii) a multi-region bilinear ConvNet for person re-identification; iii) domain-adversarial adaptation by backpropagation; iv) practical domain adaptation for face recognition.

*The introductory chapter* sets the context and states the motivation of the conducted research of the conducted research on person re-identification and face recognition, 'how to approach human performance with convolutional neural networks?'. Then it lists the datasets and the architectures used in this thesis, as well as the four main contributions corresponding each to one chapter: a new histogram loss for training similarity-based siamese neural networks, a novel architecture for person re-identification, a domain adaptation model applied to re-identification, a practical pixel-level domain adaptation strategy for face recognition.

*The related work chapter* provides the necessary background on metric learning, learning to rank and handcrafted representations for person re-identification. Then notions and related works on deep learning for similarity estimation and deep architectures for human recognition are provided. Finally, the multiplicative interactions of features and the domain adaptation are covered as means for improved performance and robustness in person re-identification and face recognition.

*The first contribution* of the thesis, on learning deep embeddings with a proposed histogram loss, is introduced in the third chapter. The chapter is based on a NIPS 2016 published paper, and introduces the problem and the motivation to then describe the proposed histogram loss, the experiments and the results. The new loss is used for training similarity-based siamese neural networks to build a mapping from image domain to a descriptor space where the distance is a measure of semantic similarity in the original image space. In comparison with existing approaches, the proposed loss and training is simpler, more robust, has fewer (hyper-)parameters.

*The second contribution* of the thesis is a novel ConvNet framework for person re-identification and is described in the fourth chapter of the thesis. The proposed solution combines deep metric learning of Yi et al. (2014) with multi-region pooling variant of the bilinear ConvNet of Lin and Maji (2015). The solution was introduced first in an AVSS 2017 paper. The multi-region bilinear ConvNet is a middle ground between bilinear and common ConvNet approaches.

*The third major contribution* is described in the fifth chapter of the thesis -- domain-adversarial adaptation by backpropagation applied to person re-identification (published as a JMLR 2016 paper). In order to apply to the domain-adversarial learning to person re-identification the task-specific label predictor is replaced by a siamese subnet which maps pedestrian images into a descriptor space. Quantitative results on eight domain pairs support the design.

*The fourth contribution* to practical domain adaptation for face recognition is introduced in chapter six. The author compares image-based domain adaptation techniques for face recognition when the images are affected by strong degradations. Particularly, the CycleGAN of Zhu et al. (2017) is used to translate between surveillance and Internet face image domains. A number of experiments are conducted and the results are discussed. A suggested image-level domain adaptation is shown to perform better than the feature-level domain adaptation method described in the fifth chapter.

The PhD thesis concludes with chapter eight, a summary of the contributions.

The PhD thesis has a modular structure and is easy to follow. The main topic of the thesis is human recognition with the two main facets: person re-identification and face recognition. The authors provides a good introduction and background on the topic with literature review and goes into necessary details along with the contributions. The main contributions are found in chapters three to six. Each such chapter can be seen as a standalone problem formulation, solution description and evaluation. This also is my main criticism: the proposed contributions while addressing the same human face recognition problem are rarely studied together. The research questions are stated clearly, as well as the contributions and the novelty. The author relates the contributions in the thesis to the relevant works from the research literature and most of the necessary background, technical and theoretical details are provided. Moreover, the author experimentally validates the proposed solutions against state-of-the-art methods on public benchmarks to achieve comparable or significant improvements. The publicly released codes prove the adherence to open research of the PhD candidate and the reproducibility of her work. The conducted doctoral research resulted in a number of 3 (peer reviewed) published papers in top vision and machine learning venues, which were integrated in the PhD thesis.

I, Dr. Radu Timofte, consider that the PhD thesis contains important contributions with significant impact in the research community.

I recommend acceptance of the PhD thesis of the PhD candidate Evgeniya Ustinova.

**Provisional Recommendation**

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense