

## 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

**Name of the Reviewer:** Associate professor Evgeny Burnaev

I confirm the absence of any conflict of interest	<b>Signature:</b>  <b>Date: 11-11-2019</b>
---	---

*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

The thesis addresses the problems related to image retrieval, namely the training of deep neural networks is considered for person re-identification (retrieval of pedestrian images) and face recognition.

The author considers two important challenges related to this important problem. The first challenge is how to construct a feature extractor, such that for images of the same person it provides similar features. The author considers siamese-based architectures to construct the feature extractor.

The second challenge is related to construction of transfer learning methods capable to tune the model for images with different statistical properties. E.g. images from the train set can be of high quality, but the model can be applied to images from the low-dimensional industrial camera.

Two new methods are developed for siamese-based training. The novel objective function allows to get rid of data-specific hyper-parameter, which is achieved by comparing the two distributions of similarity values for matching and non-matching pairs of examples.

Besides the novel objective function the architecture, used for feature extraction, incorporates the new Bilinear layer (taken from Bilinear CNNs) that allows to enrich the feature representation making it better for a number of person re-identification datasets, as evidenced from the extensive experiments.

The presented results are demonstrated for several publicly available datasets and show the suggested methods to be relevant to the considered tasks. The scientific significance is evidenced by the quality of the corresponding publications (A\* and B – level conferences), as well as by the RF patent.

The cross-domain part (related to transfer learning approaches) demonstrates several important results for the cross-domain person re-identification and surveillance face recognition. The former demonstrates the applicability of domain-adversarial training to non-classification problems and is published as a part of a larger submission to a top-ranked journal (JMLR).

The last part considers a case of using existing face recognition models for surveillance data and extensively evaluates and compares the state-of-the-art strategies of deep domain adaptation for this task. Such results give an intuition that may be useful for building a real-world face recognition system. Moreover, it considers a strong domain shift that is hardly addressed in recent literature (the author claims that she found only two closely related papers on the moment of submission, but for different data; the author also demonstrated her results on the proprietary data from Moscow subway). The results, related to application of unpaired learning approaches (based on so-called cycle GAN), demonstrate that image-based domain adaptation helps and is better than feature-level domain adaptation.

The introduction gives the description of the scope, topic, tasks and the context of the thesis. The above-mentioned results are presented in the four corresponding chapters of the thesis and structured in an appropriate manner.

Thus, the overall structure of the dissertation is logical; separate sections of the dissertations correspond to different steps of the pipeline, proposed by the author for solving the problems of person re-identification (retrieval of pedestrian images) and face recognition. The topic of the dissertation is fully relevant to its actual content. The methods are novel, and results of experiments support their efficiency. The obtained results are significant as they are based on solid mathematical ideas and provide grounds for the development of efficient image analysis methods; competitive performance with SOTA methods as well as papers in top venues supports compliance of the results with the international level and current state of the art. The author made experiments not only on available open datasets, but also on proprietary dataset from the Moscow subway,

and obtained competitive accuracy; this proves the relevance of the obtained results to applications.

The thesis is accurately written. There were some technical misprints, which had been operatively corrected by the author.

During the defense it could be interesting to discuss the following questions:

- Does accuracy of the histogram estimate influence the proposed loss for feature learning; if yes, then how? should we somehow take into account confidence intervals, which can be calculated for the histogram estimate?
- What if we use standard distances between distributions such as KL distance and maximize it during feature learning instead of the proposed histogram loss?
- It could be good to discuss intuition behind the approach to fine-grained recognition.
- Why only two streams have been used for fine-grained recognition?

In any case, the work is solid, it fulfils all requirements to PhD thesis. Actually, I do not expect detailed answers to questions above (as they require a separate line of research), rather I would like to listen to the author's opinion.

**Yes:** *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*