Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Daniil Kononenko

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Learnable warping-based approach to image re-synthesis with application to gaze redirection.

Supervisor: Professor Victor Lempitsky

Chair of PhD defense Jury: Professor Maxim Fedorov   *Email: m.fedorov@skoltech.ru*

Date of Thesis Defense: October , 2017

Name of Reviewer:

I confirm the absence of any conflict of interest	**Signature:** **Date: 01-10-2017**

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 forward a completed copy of this report to the Chair of the Jury 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 describes the methodology of image resynthesis for a specific application to so-called gaze redirection problem. The input to the problem of image resynthesis is the dataset of (input/output) images and the mapping from the input into desired output is sought. The main challenge is the monocular architecture, which does not require stereocamera or eyetracking solution. The monocular architecture can be readily implemented using the standard web-camera, thus it justifies the practical value of the research. It is also an unsolved research question, which in the dissertation is tackled by different means, finally leading to an industrial solution which was licensed to a commercial company.

The dissertation is 123 pages long, contains 4 chapters, introduction and conclusions. One of the main ideas is to learn the warping field, not the output image directly; this helps to avoid overfitting. "Deep Warping Architecture" is studied (this is a joint work with Yaroslav Ganin, so it is not one of the main results of the dissertation, but provides a basis for it). The DeepWarp architecture provides better quality, but the random forest architecture is faster. Also, the DeepWarp architecture has a bigger memory footprint: as noted in the beginning of Section 5, it takes 200 Mb (it is not clear to me, if 200 Mb nowadays is big for the applications considered). Thus, the author proposes to use a teacher-student architecture, where a neural network (teacher) teaches the student (random forest architecture). An attempt to verify the result using the prediction of the real angle is done, but it is quite suspicious to me: another neural network (denoted model E on page 80), which gives quite large variance which is attributed to "imperfection of evaluation network". I do not think the conclusions provided in the newly added material on pages 80-82 are well justified, but it is only a minor remark.

To summarise, 4 different methods for the same problem were proposed using different techniques. The main challenge is the architecture of the models and losses, and also validation of the results; the thesis does not contain any mathematical foundations for the proposed methods, but I think it is of great practical and algorithmic value. Moreover, the approaches that are described are novel and were published in top conferences, which justifies the importance of the results to the community. A weak point is that in such problems is very difficult to quantify what is meant by "photorealistic", and how to compare the quality of the methods. A user study has been done, but the statistical significance of the results of this study (and the question if the selection of users was representative) is a separate story. However, this does not influence the overall evaluation of the thesis, which I can rate as of a high quality, and that it satisfies all the requirements for a PhD.

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