Review of a Doctoral Thesis at FIT BUT

Doctoral thesis (hereinafter referred to as "thesis"), title of the thesis:

Steps Towards Improvements of Computer Vision Methods for Traffic Analysis

Name of the doctoral student (hereinafter referred to as "student"), name and surname:

Jakub Špaňhel

Name and institution of the reviewer (full name of the reviewer, full name and country of the institution):

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I. Thesis

Appropriateness and relevance

The area and the topic addressed by the thesis is highly appropriate to the development and implementation of intelligent transportation systems. The student presents several papers that contribute to the research field either by a novel method, a novel dataset or a combination of both. The particular topics covered are Vehicle Re-Identification, License Plate Recognition, Vehicle Fine-Grained Recognition, and Monocular Vehicle Speed Measurement.

A summary of the contributions of the thesis

The goal of the thesis is to improve the computer vision methods for traffic analysis. The student worked on several subfields.

For vehicle re-identification, he is the first author of Q1 journal paper, where a method for visual feature aggregation in the temporal domain for re-identification and a CarsReId74k dataset was introduced.

In the license plate recognition domain, he first-authored two conference papers with a method for recognition of low-quality license plates in a holistic way by machine learning model and two LPR datasets. The first paper introduces the method and the second one further extends it.

As a second author in Q1 journal paper, Mr. Špaňhel proposed multiple augmentation techniques for neural network training, participated in the redesign of 3D bounding box estimation from a single image, and he curated the process and further expansion of vehicle fine-grained recognition dataset BoxCars in an unconstrained environment.

As a third author of Q1 journal paper, he organized, provided and controlled the data acquisition process and post-processed the collected data for a novel, publicly available dataset BrnoCompSpeed for monocular vehicle speed measurements.

From my point of view, the thesis has achieved the chosen goal.

Novelty and significance:

As stated in the previous section, the contribution of the student is novel and can be used in practical applications in the area of traffic analysis. Especially valuable are the publicly available datasets collected by the student.

Evaluation of the formal aspects of the thesis:

The thesis consists of five parts. The total length of the thesis is 135 pages, of which the list of references (286 entries) 20 pages.

Part I introduces the topic and existing methods in traffic surveillance. Part II focuses on four collected datasets. Pert II and IV describe the proposed methods in the area of vehicle re-identification and license plate recognition. Part V states the application of the presented approach in the real world, mainly the NVIDIA AI City Challenge.

The thesis is written in English, without any noticeable inaccuracies. Overall the thesis is well structured and readable.

The Bibliography section falls behind the high level of the text parts. No page numbers are provided and in many entries only the authors, title and year are stated – not even the name of the journal (e.g. [36, 54]).

Quality of publications

The text of the thesis covers five papers by Mr. Špaňhel. He has the first, second and third authorship in three Q1 journals papers. He also first-authored two conference papers. The publishers of the papers are renowned (IEEE and Academic Press). The journal papers have high IFs.

II. Student's overall achievements

Overall R&D activities evaluation:

The student has shown his knowledge of the subject, his scientific erudition, and creative abilities. The list of published papers is 22 since 2017 with 509 citations and h-index of 9 (according to Google Scholar). This makes Mr. Špaňhel a highly successful PhD candidate.

III. Conclusion

The thesis and the student´s achievements until now meet the generally accepted requirements for the award of an academic degree (in accordance with Section 47 of Act No. 111/1998 Coll., on higher education institution), therefore, after a successful defense, I suggest awarding the PhD title.

Prague 10.04.2024 Signature of the reviewer: