



Supervisor's statement of a final thesis

Student: Bc. Boris Laskov
Supervisor: prof. Ing. Daniel Sýkora, Ph.D.
Thesis title: As-Rigid-As-Possible Optical Flow Estimation on the GPU using Dual Numbers
Branch of the study: Web and Software Engineering

Date: 3. 6. 2019

<i>Evaluation criterion:</i>	<i>The evaluation scale: 1 to 4.</i>
1. Fulfilment of the assignment	<u>1 = assignment fulfilled,</u> 2 = assignment fulfilled with minor objections, 3 = assignment fulfilled with major objections, 4 = assignment not fulfilled
<i>Criteria description:</i> Assess whether the submitted FT defines the objectives sufficiently and in line with the assignment; whether the objectives are formulated correctly and fulfilled sufficiently. In the comment, specify the points of the assignment that have not been met, assess the severity, impact, and, if appropriate, also the cause of the deficiencies. If the assignment differs substantially from the standards for the FT or if the student has developed the FT beyond the assignment, describe the way it got reflected on the quality of the assignment's fulfilment and the way it affected your final evaluation.	
<i>Comments:</i> The aim of the thesis was to study optical flow estimation problem with the emphasis on techniques that allow to locally reduce the number of degrees of freedom so that the resulting deformation field can be represented by a set of interconnected rigid-body transformations. This problem leads to a nonlinear optimization for which the L-BFGS method where the first order derivative can be calculated analytically using the concept of dual numbers. The resulting implementation was supposed to use GPU within CUDA framework. Student started with an existing single-core CPU implementation, rewrote a substantial part of the given algorithm and modified several parts to achieve parallelism on the GPU. Detailed evaluation of the resulting implementation demonstrates significant speed-up while still maintaining comparable accuracy as the original single-core version.	
<i>Evaluation criterion:</i>	<i>The evaluation scale: 0 to 100 points (grade A to F).</i>
2. Main written part	100 (A)
<i>Criteria description:</i> Evaluate whether the extent of the FT is adequate to its content and scope: are all the parts of the FT contentful and necessary? Next, consider whether the submitted FT is actually correct – are there factual errors or inaccuracies? Evaluate the logical structure of the FT, the thematic flow between chapters and whether the text is comprehensible to the reader. Assess whether the formal notations in the FT are used correctly. Assess the typographic and language aspects of the FT, follow the Dean's Directive No. 26/2017, Art. 3. Evaluate whether the relevant sources are properly used, quoted and cited. Verify that all quotes are properly distinguished from the results achieved in the FT, thus, that the citation ethics has not been violated and that the citations are complete and in accordance with citation practices and standards. Finally, evaluate whether the software and other copyrighted works have been used in accordance with their license terms.	
<i>Comments:</i> The thesis is formally and typographically well done. I appreciate the choice of English language. The structure of the thesis is adequate. From the text it is clear student has insight into the studied problem and understands more complex algorithmic details. The scope of work corresponds to the complexity of the studied problem. Student made a detailed overview of related work. The sources used are cited correctly.	
<i>Evaluation criterion:</i>	<i>The evaluation scale: 0 to 100 points (grade A to F).</i>
3. Non-written part, attachments	100 (A)
<i>Criteria description:</i> Depending on the nature of the FT, comment on the non-written part of the thesis. For example: SW work – the overall quality of the program. Is the technology used (from the development to deployment) suitable and adequate? HW – functional sample. Evaluate the technology and tools used. Research and experimental work – repeatability of the experiment.	
<i>Comments:</i> The quality of the resulting implementation is excellent. In addition to the original assignment the code includes also a parallel CPU version which is highly beneficial for target platforms that do not support CUDA framework.	
<i>Evaluation criterion:</i>	<i>The evaluation scale: 0 to 100 points (grade A to F).</i>
4. Evaluation of results, publication outputs and awards	100 (A)

Criteria description:
Depending on the nature of the thesis, estimate whether the thesis results could be deployed in practice; alternatively, evaluate whether the results of the FT extend the already published/known results or whether they bring in completely new findings.

Comments:

I am satisfied with the thesis' results. The final implementation has an immediate application in video processing where the calculation of dense correspondences between distant frames is inevitable. It can be used, e.g., for transferring visual style from a single frame to the rest of the video sequence. The possibility of interactive optical flow estimation is crucial in this scenario. The work has publication potential. We plan to submit a paper.

Evaluation criterion:

The evaluation scale: 1 to 5.

5. Activity and self-reliance of the student

5a:
1 = excellent activity,
2 = very good activity,
3 = average activity,
4 = weaker, but still sufficient activity,
5 = insufficient activity
5b:
1 = excellent self-reliance,
2 = very good self-reliance,
3 = average self-reliance,
4 = weaker, but still sufficient self-reliance,
5 = insufficient self-reliance.

Criteria description:
From your experience with the course of the work on the thesis and its outcome, review the student's activity while working on the thesis, his/her punctuality when meeting the deadlines and whether he/she consulted you as he/she went along and also, whether he/she was well prepared for these consultations (5a). Assess the student's ability to develop independent creative work (5b).

Comments:

Student was working responsibly. Often consulted with the supervisor and published preliminary results on a shared GitHub repository.

Evaluation criterion:

The evaluation scale: 0 to 100 points (grade A to F).

6. The overall evaluation

100 (A)

Criteria description:
Summarize which of the aspects of the FT affected your grading process the most. The overall grade does not need to be an arithmetic mean (or other value) calculated from the evaluation in the previous criteria. Generally, a well-fulfilled assignment is assessed by grade A.

Comments:

Even though the assignment of this diploma thesis can be considered as difficult, the student succeeded in its fulfillment.

Signature of the supervisor: