

## I. IDENTIFICATION DATA

<b>Thesis title:</b>	<b>The NeRF Utilization in Dense Reconstruction</b>
<b>Author's name:</b>	<b>Jakub Sakař</b>
<b>Type of thesis :</b>	bachelor
<b>Faculty/Institute:</b>	Faculty of Electrical Engineering (FEE)
<b>Department:</b>	Department of Cybernetics
<b>Thesis reviewer:</b>	Jonáš Kulhánek
<b>Reviewer's department:</b>	Applied Algebra and Geometry, Czech Institute of Informatics, Robotics and Cybernetics (CIIRC)

## II. EVALUATION OF INDIVIDUAL CRITERIA

<b>Assignment</b>	<b>extraordinarily challenging</b>
<i>How demanding was the assigned project?</i>	
The chosen field (NeRFs) is highly competitive and out of the scope of ordinary bachelor study. In order to be able to modify existing NeRF methods, the student had to show a good understanding of the inner workings of the selected methods as well as try a lot of hyperparameter configurations in order to get a custom dataset working. Overall I consider the thesis assignment challenging.	

<b>Fulfilment of assignment</b>	<b>fulfilled</b>
<i>How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.</i>	
To the best of my knowledge, all required points from the assignment were fulfilled.	

<b>Methodology</b>	<b>correct</b>
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
Student extended mip-NeRF with the DS-NeRF loss function. The idea is sound, and the obtained results of NeRF and Mip-NeRF on student's scenes seem plausible. I am worried about an erroneous claim about finding an error in the DS-NeRF loss function, but hope student can explain in his defense (as will be stated later).	

<b>Technical level</b>	<b>C - good.</b>
<i>Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?</i>	
The student has shown a great level of understanding of the MultiNeRF repository, which is the official implementation of Mip-NeRF 360. Although there were some erroneous statements in the thesis (e.g., claiming that no NeRF method utilised information about depth, claiming that no present NeRF method can handle more than 20 images, or claiming that DS-NeRF uses rendering equation 3.43 instead of the one defined in NeRF), I consider them out of the scope of the required knowledge for a bachelor student. Although I would have liked it more if there were more details on the method, it didn't prevent me from understanding what was done. Overall I was satisfied with the technical level. However, one thing is still unclear to me: the student claimed to have found an error in the DS-NeRF loss and proposed an alternative. To me, both losses seem to have the same gradient, and there should be no difference between the two. This perhaps points to a bug in the implementation.	

<b>Formal and language level, scope of thesis</b>	<b>B - very good.</b>
<i>Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?</i>	
The student has shown good use of the English language - exceptional for a bachelor student. The formalism used in the thesis matched the formalism from the original papers, which made it easy to follow. There were some noticeable typos, and one section was copied twice in the thesis text, but	

overall the thesis was quite readable. However, in terms of the content, I felt like the results could have been analysed in more detail, and the discussion could have been longer. The thesis felt a bit unfinished towards the end. My main concern was that there were no quantitative results given (PSNR, SSIM), which I would appreciate and I think could have made the thesis really stand out.

## **Selection of sources, citation correctness**

**B - very good.**

*Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?*

Student correctly identified some influential works in the NeRF field. I greatly appreciated descriptions of NeRF, mip-NeRF, mip-NeRF 360, and Ref-NeRF in the theoretical background section of the thesis. However, I would have enjoyed a wider literature review putting current NeRF into the context of novel view synthesis and mentioning traditional NVS as well as recent NeRF approaches. I acknowledge that this might have been difficult for a bachelor student in the fast-evolving neural scene representation field.

## **Additional commentary and evaluation (optional)**

*Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.*

## **III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE**

*Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.*

The grade that I award for the thesis is **B - very good.**

I would like to congratulate the student on choosing and successfully completing a work in a very challenging and highly competitive field (NeRFs), which, to the best of my knowledge, is far from the bachelor curriculum. As he demonstrated in his thesis, the student was able to get an understanding of the field and contribute with his work which combines two prior methods. I believe having a wider literature review and more detailed evaluation would have made this thesis much better, but even in the current state, I believe the student had performed well. However, there is a concern with the student's claim about finding an error in the loss function. I believe the loss function in the DS-NeRF and the student's proposed loss functions should have the same gradients, and any reported difference in the performance points to an incorrect implementation. However, overall I was happy with what the student achieved.

### **Questions for the student:**

**What is the difference in terms of gradients between the DS-NeRF loss function and the loss function proposed in the thesis? If there is no difference in terms of gradients, why do the two losses yield different results?**

How did you obtain the dense depth maps used in the training for your forward-facing dataset?

Why do you think using NDC space makes so much difference in quality in your scene, and under what assumptions is NDC space beneficial?

Date: **2.6.2023**

Signature: