

## I. IDENTIFICATION DATA

<b>Thesis title:</b>	<b>Benchmarking 6D Object Pose Estimation for the Pick and Place Task.</b>
<b>Author's name:</b>	<b>Bc. Vít Zeman</b>
<b>Type of thesis :</b>	master
<b>Faculty/Institute:</b>	Faculty of Electrical Engineering (FEE)
<b>Department:</b>	Department of Cybernetics
<b>Thesis reviewer:</b>	Ing. Varun Burde
<b>Reviewer's department:</b>	Czech Institute of Informatics, Robotics, and Cybernetics

## II. EVALUATION OF INDIVIDUAL CRITERIA

<b>Assignment</b>	<b>challenging</b>
<i>How demanding was the assigned project?</i>	
The thesis aimed to explore, implement, and experiment with an RGB-based 6D object pose estimation method that would aid in deploying assembly lines in Testbed, CIIRC, to demonstrate a flexible production line. The integral part of the thesis was to compare a few pose estimation methods and report their performance on new objects. For that, students need a good understanding of computer vision concepts. Demonstrating its real-time application on robots or simulations requires engineering and software skills, so the task is 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>	
The student demonstrated sufficient understanding of the task and state of the art through literature review. The evaluation of the various methods was clearly documented, and the dataset and evaluation methodology were done correctly. The benchmark provides insight into various methods and their real-world performance. Moreover, the pick and place operation of the objects has been demonstrated using real robots.	

<b>Activity and independence when creating final thesis</b>	<b>A - excellent.</b>
<i>Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.</i>	
The students made the necessary effort and motivation to understand the task and find the solution. He was interested in finding the performance shift if the mesh is textured or untextured. He took extra effort to reconstruct the mesh where the object's CAD models were unavailable/untextured. The student faced many challenges while creating the dataset and benchmark; he was patient enough to review the literature from time to time to understand the concept and consult me.	

<b>Technical level</b>	<b>B - very good.</b>
<i>Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?</i>	
The student clearly distinguished his contribution and the provided setup. The pros and cons of the methods were clearly stated. The results were visualized in the form of tables. The discussion of results was rather general, and interpretations were from general observation but meaningful. The more in-depth interpretation of the number could have given a better insight into the performance of different methods, or the use of bar graphs would have been beneficial for visual representation.	

<b>Formal level 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>	
Although a lot of work has been done on the thesis, the thesis's written part needed to be stronger, and further effort could be made to improve its readability. Although the informal text can be seen in some sections and some sections can be explained in more detail, the thesis's primary objective and goal were understandable. Proofreading would have improved	

the readability and corrected some spelling mistakes.

## Selection of sources, citation correctness

**A - excellent.**

*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?*

The student cited 41 references, which consist of relevant and essential literature. Most references were from highly influential conferences and journals. The student was precise while stating his contribution and using the existing work.

## 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.*

Although the writing part is a bit weak, I chose to award an A-excellent for the extra effort to deliver details on the benchmark and motivation to learn 3D reconstruction and search for the best possible solution.

### 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.*

The thesis presents the topic of object pose estimation, which is essential for pick-and-place operations in the manufacturing industry. Employing object manipulation for new objects requires a change in setup. The thesis reported on the performance of the various pose estimation methods on new objects and their influence when the object representation (CAD model) was noisy or inaccurate. The benchmark and discussion provide insight and direction for improvement to the problems.

The work presented was of good quality overall. The benchmark provides insights into the method and its applicability to real-world objects. The object pose estimation and computationally extensive tasks were implemented using the cloud infrastructure, showcasing student problem-solving and engineering skills.

The grade that I award for the thesis is **A - excellent**.

Questions:

Megapose has been a state-of-the-art method for object pose estimation in the BOP challenge. Can you give a reason why your dataset's performance is so low compared to other datasets?

Date: **22.1.2024**

Signature: