



### ***Review of USB FFPW PhD thesis***

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| <b>First name(s), surname, titles of the PhD student:</b><br>Dinara Bekkozhayeva, M.Sc. | <b>First name(s), surname, titles of supervisor:</b><br>Dipl.-Ing. Jan Urban, Ph.D. |
| <b>Title of PhD thesis:</b><br>Fish biometric using machine vision                      |                                                                                     |

#### **REVIEWER:**

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| <b>Surname:</b> Železný                                                   | <b>Institution:</b> ZČU, Plzeň                                            |
| <b>Name:</b> Miloš                                                        |                                                                           |
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| <b>Please describe your professional relationship to the PhD student:</b> | <b>Please describe your field of expertise:</b>                           |

### **QUESTIONNAIRE**

#### ***Originality, scientific importance, perspectives and impacts of results presented in the PhD thesis for basic and/or applied research***

Evaluate competitiveness of the PhD thesis in the international context and compare its level with the current state of the art in the field (**extent ¼ – ½ page**):

The thesis presents a new approach for identification of individual fish in a larger pool of the same species. This field is very specific and is not much covered by the scientific community. The results presented in the thesis are very competitive in comparison to the state-of-the-art. The methods proposed are backed by publications in peer reviewed international journals with impact factors and on international conferences. Results are more oriented for applied research. The author hopes to implement an approach based on deep neural networks in the future as a continuation of this research. The main perspective lies in the development of system based on noninvasive identification method which can ease the process for the fish identification in comparison to the invasive method and to provide a reliable and fast way to identify individuals in larger groups.



### ***Elaboration of the PhD thesis, objectives of the work and deliverables***

Evaluate the overall level of elaboration of the PhD thesis (structuring of the main text, comprehensibility, logicity of the chapters and their ordering) and the originality of the selected approaches to solve the objectives; evaluate publications and whether the results described correspond to objectives of the PhD thesis (extent  $\frac{1}{4}$  –  $\frac{1}{2}$  page):

The text of the thesis is well structured. The structure follows the natural progress of the research and complies with recommended guidelines given by University of South Bohemia. Objectives of the research were met in full. The approach is original, and it evolves procedures developed by Petr Císař and his research group. The papers presented in the thesis correspond with the topic and follow the complete structure of the research goals. From the point of view of computer vision the general summary that that follows the papers lacks some important information about the data structure used for training and testing the algorithms which can be found in the papers. The level of English is very good with minimal errors and comprehensibility issues. I have to note that (especially as the thesis is oriented in a computer vision domain) the thesis lacks the quality in the graphical part. The pictures with examples are all different sizes and are not very well put together – for example in Figure 1 on page 13. The inclusion of the papers is done in such a way that compression of the text makes it hardly readable after zooming. Lastly there is a problem with the Literature section which does not adopt a unified structure and some items start with author name instead of surname, which causes confusion when the reader tries to find the citation from the text that is done by surname.

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### ***OVERALL COMMENTARY ON THE PhD THESIS***

Please write in the box specific comments concerning the PhD thesis in extent of 1-2 pages:

The thesis presents a new and original approach for individual fish identification in larger pool of the same species. The goal was finding a specific feature on fish body that is distinctive between individuals of the same species and is stable in the fish lifetime. The research follows a logical path and is well structured from the initial experiments to the final tests focused on time stability of selected features. Since there is not extremely large amount of data available, rather classical approaches of computer vision were selected. Some experiments also involve Deep Neural Networks, but they are outperformed by classical methods which are not so dependent on large data. The core papers are published in impacted international journals and provide a good overview of individual research steps. All the papers are on topic of the thesis. The overall quality of the accompanying text of the thesis is good and comprehensible with some small errors present. The graphical part is informative but lacks the quality. The images in figures are not very well composed together – each image is of different shape and size with different gaps between them. Papers are included as images in compressed format instead of vector graphics which cause them to become unreadable if the electronic version of the thesis is zoomed. From the point of view of computer vision the results presented in the general summary outside of the papers are lacking explanation about the data structure. How was the data split into train, test, and validation sets? On which part of this data is the accuracy provided in the results measured? The explanation can be found in the papers, but it should be also included in the summary. I



would also like to point out that 100% accuracy can cause a raised eyebrow in the computer vision community since this result can also be caused by an error in the experiment. Here it can be explained with a small number of samples (around 40 in one experiment and around 330 in the other) but nevertheless it can be met with skepticism. The author wants to focus on utilization of neural networks in the future which will require much more data to provide functional system. Overall, the thesis forms a complete structure and meets the requirements of University of South Bohemia. I recommend the thesis for defence.

### **FINAL RECOMMENDATION**

- ☒ PhD thesis can be recommended for defence  
☐ PhD thesis can be recommended for defence with reservations  
☐ PhD thesis cannot be recommended for defence

Plzeň, 18. 7. 2022

Date and place

Miloslav Železný

Name and signature