THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Unconventional Techniques for Computational Holography (Nekonvenční techniky pro výpočetní holografii)**
Author's name:	**Arda Özdoğru**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Radioelectronics
Thesis supervisor:	Ing. Karel Fliegel, Ph.D.
Supervisor's department:	FEE CTU in Prague, Department of Radioelectronics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

Despite being around for decades, the topic of holography is still challenging, considering its demanding theoretical and practical implications. This thesis focuses on emerging digital and computer-generated holography techniques. While this topic is tackled in the master study program rather superficially, the student had to study first the relevant theoretical background, then get familiar with the recent advances published in the research papers and other resources. Both core topics, i.e., theoretically treated utilization of spherical harmonics in holography and practically tackled visualization of holograms on light field display, are challenging for the typical levels of master projects.

Fulfilment of assignment **fulfilled with minor objections**

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.

The assignment's main tasks were to provide a state-of-the-art review of digital holography acquisition, processing, and display techniques with a primary focus on optical setups and image processing in hologram encoding and display, including unconventional approaches. Selected techniques were to be implemented, and their performance evaluated. These main tasks of the assignment have been fulfilled, while there are two core topics discussed. Namely, the utilization of spherical harmonics for encoding and image processing workflow to display holographic images using light-field display. The utilization of spherical harmonics has been discussed theoretically with issues identified in an unfinished computer simulation. The tools for visualization of holograms using light field display have been successfully implemented, but thorough performance testing is missing.

Activity and independence when creating final thesis **B - very good.**

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.

Arda Özdoğru worked on the assignment independently and carried out this topic as an extension of a previously solved semester project. The techniques selected for in-depth exploration by the student were very timely and interesting. Still, mainly spherical harmonics-based encoding of holograms has turned out to be beyond the scope and time limitations of the master thesis. Thus, in the practical part of the work, a hologram visualization tool for the light-field display has been selected. The student tends to target very challenging goals, which is a positive personal quality. However, he usually underestimates the workload required to fulfill the set goals within the imposed timeframe. The student regularly consulted the progress and was well prepared for the discussions. He proved the ability to work independently and successfully solve complex problems.

Technical level **C - good.**

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?

The student builds the described techniques from the ground up, starting with the theoretical background (holography and light), developing interesting extensions (application of spherical harmonics), and ending with the practical application

of the studied methods (visualization of holograms on light field displays). The presented thesis is technically sound and explains well what has been done. However, the theoretical background and state-of-the-art are in selected sections studied deeper than required, and the proposed techniques, including the experimental design, would deserve a more considerable extent and more detailed explanations. The work would benefit from a broader performance evaluation of the proposed techniques compared to the prior art, which is missing.

Formal level and language level, scope of thesis **B - very good.**

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?

The student has paid adequate attention to the formal level of the submitted thesis. The language and terminology are used correctly and in line with the relevant prior art in the field. The language is clear and understandable, and only very few typos and grammar imperfections could be identified. There is a relatively high extent of figures and illustrations taken from the external references, though adequately cited. The extent of the work is adequate. However, the experimental part would benefit from extension and more detailed analysis.

Selection of sources, citation correctness **C - 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?

The previous art is studied thoroughly, and the development is put in the context of the most recent activities in the field, e.g., JPEG Pleno Holography. However, in some parts of the work, especially describing the display technologies, the work would benefit from more recent references. The student's original work is identified, and all the references seem appropriately cited. However, it would be beneficial if the border between the prior art and the original developments is defined more clearly.

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.

The topic of this work is challenging, especially the utilization of spherical harmonics for hologram encoding. It is thus understandable that the problem is not developed to the highest level of detail, which would be well beyond the scope of the master thesis. This topic will need more research, and extending it into a scientific publication would be advisable. The tools and workflow for the visualization of holograms, presented in the experimental part, are useful practical contributions. It is also highly appreciated that the student created a GitLab repository, which makes the codes publicly available and facilitates reproducible research.

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 presented work, despite its above-identified shortcomings, is a solid attempt to contribute to the challenging field of advanced holography techniques. Arda Özdoğru proved the ability to work independently and successfully solve complex problems. Future works in this field might build on the presented findings. Thus, the thesis might be recommended for defense.

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

Date: **28.8.2023** Signature: Ing. Karel Fliegel, Ph.D.