

I. IDENTIFICATION DATA

Thesis title:	Method of Moments on GPU and Shape Synthesis Using Machine Learning Techniques
Author's name:	Martin Štrambach
Type of thesis:	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Electromagnetic Field
Thesis reviewer:	Miloslav Capek
Reviewer's department:	Department of Electromagnetic Field

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The accomplishment of the project assignment required to study wide range of numerical techniques from computational electromagnetism and implement them properly. The second part of the project required knowledge in machine learning techniques and tools from the branch of artificial intelligence. Since the GPU MoM implementation was done almost from scratch, the project is of "extraordinary challenging" to "challenging" complexity.	

Fulfilment of assignment	fulfilled
<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>	
All goals of the thesis have been achieved. The overall speedup of the implemented method exceeds the expectations and scales well with the allocated HW resources. The second part of the project revealed some interesting properties and relationships between efficient sampling and high-quality solution and identified several ways to be explored further in details.	

Activity and independence when creating final thesis	A - excellent.
<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 student worked independently based on reasonable amount of regular consultations. I highly appreciate that all conclusions made during the consultations were always incorporated right after the meeting. This is how the supervision should work.	
Moreover, since a long-term collaboration within several scientific and technology projects (GACR, TACR), Martin became a part of the team, a colleague, and a friend. His personality as well as his sense of responsibility significantly strengthen the group and I am sure he will enhance the working capacity of any team he decides to become a part of.	

Technical level	B - very good.
<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 results presented in the thesis are correct so as the theoretical and practical tools used. At few places, some steps are not clearly motivated, which is, however, logical price for the multidisciplinary work. The second part of the thesis is of scientific nature, surely exceeding the standard demands on technical level of a diploma thesis.	

Formal level and language level, scope of thesis	A - excellent.
<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 thesis is 62 pages long with the chapters being well structured. The only complaint here is the text between Chapter 5 and Chapter 6, where its flow is not as good as it could be. This is, however, only a tiny comment and no one should	

expect that the student at master's level has advanced skill of writing technical/scientific texts. This proficiency is to be improved with the practice of upcoming years.

The level of presentation is far above the standards at CTU – thesis is carefully typed in LaTeX, all figures are made in TikZ (vector graphics), the equations are typeset strictly according ISO/ANSI standards, and the thesis is written in English with acceptably low level of grammatical errors. In fact, English used fully corresponds to the experience of a master's student.

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 thesis has reasonable number of citations (60+). Their appearance and usage are adequate.

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.

I acknowledge Martin's courage and diligence to choose and work on a topic slightly outside his proficiency. I have enjoyed many fruitful discussions when an "EM" and "IT" worlds met up (well, sometimes, crashed) trying to find a solution to the common, yet unsolved, problem of shape synthesis. Such multidisciplinary theses should be highly welcomed and appreciated by the university. They represent a way how to find new collaborations, think about problems from different perspectives, and, ultimately, to learn something truly new. My only regret is that Martin have decided not to continue with his Ph.D. studies.

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

The challenging topic with a scientific overlap has been completely treated. The resulting code has been fully incorporated into existing EM package and has a potential to be used in everyday work. With this respect, Martin showed his proficiency as skilled programmer. Even more importantly, he manifestly demonstrated his ability to study and master new topics and merge various technical branches in multidisciplinary manner – a skill required for the upcoming era of ubiquitous artificial intelligence and autonomous systems.

Questions:

1/ *The (NP-)hardness of the shape synthesis problem has never been proved. Can you comment possible techniques to do so? Can its similarity to a problem of known complexity be identified and utilized?*

2/ *Machine learning techniques helped with identification and classification of known solutions; however, they were unable to find, or at least assist to find, the solution. What is your opinion on utilization of these heuristics and approximations to solve the complex non-linear problems (in fact, a large class of engineering problems)?*

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

Date: **26.5.2020**

Signature: Miloslav Čapek