

## I. IDENTIFICATION DATA

<b>Thesis title:</b>	<b>Method of Moments on GPU and Shape Synthesis Using Machine Learning Techniques</b>
<b>Author's name:</b>	<b>Martin Štrambach</b>
<b>Type of thesis :</b>	master
<b>Faculty/Institute:</b>	Faculty of Electrical Engineering (FEE)
<b>Department:</b>	Department of Computers
<b>Thesis reviewer:</b>	doc. Ing. Miloslav Capek, Ph.D.
<b>Reviewer's department:</b>	Dept. of General Electrical Engineering, School of Electrical Engineering, University of Belgrade, Serbia

## II. EVALUATION OF INDIVIDUAL CRITERIA

<b>Assignment</b>	<b>challenging</b>
<i>How demanding was the assigned project?</i>	
The master thesis covers several scientific fields: numerical electromagnetics, computer science (parallelization of the code using CUDA technology), optimization theory and artificial intelligence (machine learning and neural networks). Therefore, the assignment of the thesis is (very) 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 thesis meets all the assignments.	
<b>Methodology</b>	<b>outstanding</b>
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
The method of moments (MoM) is applied to solve the radiation/scattering problems in numerical electromagnetics. For such problems, MoM is known to be the most computationally efficient method. The authors used Galerkin testing procedure, which is known to minimize the numerical error in the most meaningful way and as such has been used by the best numerical electromagnetic solvers today. Further, the CUDA technology is used for the porting the MoM code to graphical cards. This approach is the state-of-the-art today in the computational electromagnetics. Finally, a research into the use of machine learning applied to solving hard optimization problems for antenna design is conducted.	
<b>Technical level</b>	<b>A - excellent.</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 thesis is technically sound. The author conducted numerical experiments to prove its applicability, using significant computing resources. The student employed the expertise very well. It is clearly stated what was done throughout the thesis.	
<b>Formal and language level, scope of thesis</b>	<b>A - excellent.</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 correctness of usage of formal notation is excellent. There are practically no typographical errors. The use of English language is well above average scientific English that is found nowadays.	
<b>Selection of sources, citation correctness</b>	<b>B - very good.</b>
<i>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?</i>	



## THESIS REVIEWER'S REPORT

Given the vast scope of literature in numerical electromagnetics, method of moments, optimization and artificial intelligence it is practically impossible to provide all relevant sources. However, the choice of reference in the thesis is very good. The results from references are correctly distinguished from the results of the thesis. No citation ethics has been breached. All bibliographic citations are complete and in accordance with citation convention and standards, to the best of my knowledge.

### **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.*

No additional comments.

### **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 thesis topic is challenging. It covers multiple scientific fields: numerical electromagnetics, computer science (parallelization of the code using CUDA technology), optimization theory and artificial intelligence (machine learning and neural networks). All the proclaimed assignments are fulfilled.

The thesis is technically correct and applicable. The student demonstrated very clear insight into the topic of the thesis. The expressions are very clear and the use of English language is well above average scientific English in use nowadays.

The proposed questions that should be answered during the presentation and the defense of the student's work:

(1) the student should comment on the relation between NP-completeness from the theory of computational complexity and the electromagnetic optimization problem that was considered in the thesis and

(2) given an electromagnetic optimization problem, as the one considered in the thesis, is it more efficient (from the stand point of using minimal computational resources over fixed time period) to solve the problem using machine learning or the optimization algorithms (e.g., genetic algorithm, particle swarm optimization etc.)?

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

Date: **1.6.2020**

Signature: Dr. Dragan Olćan, Associate Professor  
School of Electrical Engineering  
University of Belgrade, Serbia