

I. IDENTIFICATION DATA

Thesis title:	The Mathematics of Compressed Sensing in MRI
Author's name:	Lenka Jacková
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Circuit Theory
Thesis reviewer:	Doc. RNDr. Martin Bohata, Ph.D.
Reviewer's department:	Department of Mathematics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The assignment was rather challenging because it required good knowledge of linear algebra, mathematical analysis, computational complexity theory, and probability theory. It was necessary to learn some mathematical tools beyond the scope of standard undergraduate courses.	

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>	
The assignment was completely fulfilled.	

Methodology	correct
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
A correct approach was chosen.	

Technical level	B - very good.
<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>	
I have found only some minor inconsistencies (see the section "Additional commentary and evaluation" below).	

Formal 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 well written and organized.	

Selection of sources, citation correctness	A - excellent.
<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>	
The student selected appropriate references. Bibliographic citations meet the standards.	

Additional commentary and evaluation (optional)
<i>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>
Comments and some typos: <ul style="list-style-type: none"> Page 23: A partial derivative of a real function at a point is a real number. Therefore, I would expect that $\frac{\partial f}{\partial \mathbf{u}}(\mathbf{u}_0, \mathbf{v}_0)$ is an n-tuple of real numbers. Indeed, we can identify this n-tuple with a linear map. However, this linear map should have the form $\mathbf{h} \mapsto \frac{\partial f}{\partial \mathbf{u}}(\mathbf{u}_0, \mathbf{v}_0) \cdot \mathbf{h}$.

- Page 30, the proof of Theorem 5.1.2: The support of \mathbf{v} is, in general, only a subset of the support of \mathbf{s}^* . This should be reflected in the next part of the proof.
- Page 31: The sign of ε should be determined by the sign of the whole sum and not only the sign of \mathbf{s}_j^* for a particular index j .
- Page 36, Theorem 6.2.6: It seems to me that the support of \mathbf{x} should be a subset of \mathcal{S} . Otherwise, it is not clear in the proof of the theorem that $\mathbf{N}_{\mathcal{S}}\mathbf{v}$ is the unique solution of the minimization problem.
- Page 42: $\|\boldsymbol{\theta}_{\mathcal{S}}^T\boldsymbol{\theta}_{\mathcal{S}} - \mathbf{E}\| \cdot \|\mathbf{x}_{\mathcal{S}}\|$ should be $\|\boldsymbol{\theta}_{\mathcal{S}}^T\boldsymbol{\theta}_{\mathcal{S}} - \mathbf{E}\| \cdot \|\mathbf{x}_{\mathcal{S}}\| \cdot \|\mathbf{y}_{\mathcal{S}}\|$.
- Page 49: It is strange to say in Example 8.3.2 that \mathbf{G} is a random matrix because its entries do not contain random variables. I also lack the definition of the Fourier matrix.

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

The bachelor thesis under review is at very good level. In my opinion, the author gives a clear exposition of some mathematical concepts of compressed sensing.

Questions:

- *Does a solution of the problem (L10) always exist? Please give a short explanation of your answer.*
- *Is there a relationship between a solution of the problem (L10) and a solution of the original ℓ_0 optimization problem?*

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

Date: **3.6.2024**

Signature: