

I. IDENTIFICATION DATA

Thesis name:	Application of one-class classifiers in differential diagnosis of dysarthria
Author's name:	Tran Duc Minh
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering
Thesis supervisor:	Ing. Jan Hlavnička
Supervisor's department:	Department of Circuit Theory

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>Evaluation of thesis difficulty of assignment.</i>	
<p>This thesis represents a multidisciplinary topic that spans statistical analysis, machine learning, acoustic analysis of pathological speech, and neurology. Although the acoustic analysis of signals was not the subject of this thesis, the knowledge about acoustic features of dysarthria was required for the development of method for feature selection and interpretation of results. The discussion of practical application requires putting findings into a wider perspective, which can be challenging for any bachelor student.</p>	

Satisfaction of assignment	fulfilled
<i>Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.</i>	
<p>All points of the assignment were fulfilled. Student analyzed more classifiers than the assignment asked for, which increases the credibility and applicability of his findings.</p>	

Activity and independence when creating final thesis	C - good.
<i>Assess that student had positive approach, time limits were met, conception was regularly consulted and was well prepared for consultations. Assess student's ability to work independently.</i>	
<p>Student's work on the thesis had two stages. First, student had to study elementary knowledge of statistical analysis, machine learning, acoustic analysis, and neurology. Student met all the terms, performed exercises and fulfilled his homework tasks. Second, student received the data and performed analysis. Student worked independently and consulted his conceptions. However, there were periods that took months when he was not capable to work on the topic due to personal reasons, which caused some difficulties in connection to his previous consultations. The manuscript and final version of his methodology and results was provided to me 3 weeks before the deadline, which is excessively late for consultation of corrections and refinements.</p>	

Technical level	B - very good.
<i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i>	
<p>Student learned from recommended literature and searched for other relevant sources of knowledge. This thesis required to gain knowledge from diverse fields and student was capable to bridge these fields and find his own perspective. In addition, student showed ability to comprehend information from various sources and to transform the content into a logical message. Student was capable to interpret results of hypotheses testing as well as accuracy analysis. I appreciate very much that student tried to discuss his results in the context of findings of other authors.</p> <p>It would be interesting if the overlap between symptoms of Huntington's disease and Parkinson's disease was enumerated—but it was not crucial part of the work. The metric used for accuracy analysis was illustrative enough and valid for this purpose.</p> <p>I have identified only few weaknesses: There are phonatory features F0 mean and F0 range listed in the chapter 2.2 Method, page 17. These features were not included in the data—they just appear here for no apparent reason.</p>	

The feature selection had to be described in more details. For example, Bonferroni correction of multiple comparisons was applied according to diagram decision " $p < 0.05/44$ " but this was not described in the text.

The figure 5 seems to have a redundant decision whether or not the feature was "significant". Significance was obviously answered by decision " $p < 0.05/44$ " in the previous step.

Formal and language level, scope of thesis

B - very good.

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

This thesis is written in clear and intelligible language. Some sentences did not convey the information correctly e.g., first sentence of the introduction give misleading information about Huntington's disease—it does not belong to the most common neurodegenerative disorders. The text is well structured. All items such as figures, tables, and equations were enumerated, described, and listed. Abbreviations and symbols were listed in nomenclature.

Half of the paragraph "phonation" in 1.2.1. Speech impairment is nonsense. It describes perception not phonation.

Anova1 is the name of MATLAB function nor a statistical test. This abbreviation can be found only in the abstract and Figure 5. Nevertheless, the Method section uses correct naming "one-way analysis of variance".

The equations and symbols are not described very well in the text. Reader must look into the list of symbols to know what some symbols mean—and not always could find the answer.

Student included the equation 8 that states " $n_{\text{freep}} = 1$ " in spite of my recommendation to not present the value of a parameter as equation—not many readers may share the same sense of humor with the author.

Selection of sources, citation correctness

C - good.

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

Student actively searched the literature and used the references appropriately in most cases. His thoughts were distinguishable from references.

The biggest weakness is that references were not ordered alphabetically and that complete bibliographic information is provided in the label of the Table 1 instead of referencing—student ignored my recommendations. In addition, some references were not listed in bibliography, e.g. Harel et al. 2004, Ruzs et al. 2015, Watson and Munson 2008.

Reference Apraxia Kids (2018) titled as "Disordered prosody and articulation in children with childhood apraxia of speech" is currently unavailable, but the title itself raises a question whether the reference is appropriate source of information about Parkinson's disease.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

Student achieved all the primary goals of his thesis and presented trustworthy results. Student designed a feature selection methodology based on testing of hypotheses, which is valid and appropriate, because it allows to check quality of the model by comparing findings with other studies. Student also conducted a classification experiment and evaluated his results using relevant metrics. Student provided all the codes and data used for evaluation as well as a brief documentation. His findings are interesting and have a publication potential.



SUPERVISOR'S OPINION OF FINAL THESIS

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation.

Here I have to highlight that student wrote a consistent thesis that covers a very complex topic. Since one-class classifiers are used for the analysis of pathological speech only sporadically, student could not base his solution on existing literature. Findings presented in this study are unique and no such an experiment with acoustic speech features of dysarthria was previously published. Student also demonstrated his results on a practical example, interpreted his results, and provided answers to fundamental questions on applicability of one class classifiers for assessment of dysarthria. Presented results could inspire further research as they illustrate how to overcome limited availability of speakers using one-class models. Apart from several small errors, I am satisfied with his work. There was some room for improvement, but the fundamental goals were met very well.

I evaluate handed thesis with classification grade **B - very good**.

Date: **29.1.2019**

Signature: