

I. IDENTIFICATION DATA

Thesis title:	Condenser Microphone with Sigma-Delta Conversion
Author's name:	Antonín Gazda
Type of thesis :	Bachelor's Thesis
Faculty/Institute:	<i>Faculty of Electrical Engineering</i>
Department:	Department of Radioelectronics
Thesis reviewer:	Antonín Novák
Reviewer's department:	Le Mans University, France

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The assigned project is considered to be demanding as it involves designing and implementing a condenser microphone with a novel approach of direct analog-to-digital conversion. The project requires expertise in the field of electroacoustics and an understanding of condenser microphone measurement, Sigma-Delta modulation, and hardware design.	

Fulfilment of assignment	fulfilled with minor objections
<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 largely fulfills the assigned task by exploring the concept of condenser microphones with Sigma-Delta conversion and providing a comprehensive analysis of the proposed approach. The primary goals, such as creating an equivalent circuit model, simulating the microphone's characteristics, designing and testing the PVDF conversion block, and evaluating the proposed system, have been achieved. However, some assigned tasks are incompletely covered, as detailed in my additional comments provided bellow.	

Methodology	correct
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
The approach and solution methods described in the thesis seem reasonable and technically sound.	

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>	
The thesis demonstrates technical competence in the field of electroacoustics. The student has employed their expertise by implementing an equivalent circuit model, conducting experimental measurements, designing a hardware schematic and PCB, and utilizing a DSP for demodulation testing. The explanations provided in the thesis generally convey the student's work clearly, although some areas could benefit from additional clarity and elaboration, as detailed in my additional comments provided bellow.	

Formal 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 overall organization of the thesis is logical, covering the necessary topics and presenting the findings in a sequential manner. However, there are areas where the thesis could be more extensive, such as providing a more detailed mathematical derivation (see my additional comments) and discussing the results in greater depth. The presentation and language are generally clear and understandable, but improvements can be made in terms of font size in figures and addressing minor issues related to equation numbering and terminology.

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 does make references to earlier work on the topic. The selection of sources appears to be adequate, providing a foundation for understanding the background and current state of research in condenser microphones and Sigma-Delta conversion. The student's original work is distinguishable, particularly in the experimental measurements, hardware design, and modifications made to the Sigma-Delta loop model. The bibliographic citations meet the standards.

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.

See below.

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 explores an alternative approach to constructing a microphone with a digital output by directly integrating analog-to-digital conversion into the acoustic transducer. The report discusses the key aspects of the thesis, including the introduction, condenser microphone measurement, Sigma-Delta modulation principles, hardware design and implementation, and the use of a DSP with Sigma-Delta numerical input for demodulation testing.

The introduction of the thesis provides a clear overview of the research topic and objectives. However, some minor improvements could be made to enhance clarity and consistency. For instance, in section 1.1, it is stated that numerical models are more precise than analytical models, which may not necessarily be true in all cases. Additionally, in section 1.2, equation (1.24) is presented in the z-domain (digital domain), while the surrounding equations remain in the analog domain. It is important to ensure consistency in the presentation of mathematical equations.



THESIS REVIEWER'S REPORT

Chapter 2 effectively covers the measurement of condenser microphones. To enhance understanding, it would be beneficial to include the mathematical background necessary for deriving the microphone impulse response. Additionally, further clarification is needed for Figure 2.6, which displays two curves without proper explanation of their significance.

Chapter 3 provides a comprehensive explanation of Sigma-Delta modulation principles. The content is well-written and helps readers grasp the underlying concepts effectively.

Chapter 4 discusses the hardware design and implementation aspects of the project. The information provided is concise and covers the essential details related to the design considerations, schematic and PCB design, manufacturing, assembly, and testing and evaluation.

Chapter 5 focuses on the utilization of a DSP with Sigma-Delta numerical input for demodulation testing. However, there are some areas that require further elaboration. The figures, particularly Figures 5.9, 5.10, 5.12, and 5.13, should be accompanied by detailed descriptions to provide a clear understanding of the main results.

A dedicated section for discussing the results is missing in the report. It would be beneficial to include a discussion section where the experimental results can be analyzed and interpreted in relation to the objectives of the thesis.

Note: It is advisable to address the specific concerns regarding the font size in figures and the placement of equation numbers within parentheses as part of the formatting and presentation of the final report.

Questions:

- 1) How would you plan to address the limitations identified in the thesis, such as the need for improvements in exciting the PVDF membrane?
- 2) Considering the potential cost savings and flexibility of the direct analog-to-digital conversion approach, can you discuss possible practical applications and industries that could benefit from this technology?

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

Date: 31/05/2023

Signature: