**MARMARA UNIVERSITY**

**FACULTY OF ENGINEERING**



**YOUR THESIS TITLE**

Student Name(s)

**GRADUATION PROJECT REPORT**

Department of Electrical and Electronics Engineering

**Supervisor**

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ISTANBUL, year

**MARMARA UNIVERSITY**

**FACULTY OF ENGINEERING**

**Your Thesis Title**

**by**

**Name**

**January 15, 2019, Istanbul**

**SUMBITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING IN**

**PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE**

**OF**

**BACHELOR OF SCIENCE**

**AT**

**MARMARA UNIVERSITY**

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# ACKNOWLEDGEMENTS

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**January, 2019**

**Name**

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# ABSTRACT

Truss optimization has been an attractive area for researchers in recent years. Researchers are interested in this issue to find out how they can reduce the weight and cost while the structure satisfied with the physical constraints. To accomplish these requirements, trial and error method cannot be used because lots of trials will be required. Therefore, optimization methods should be used to find an optimum structure.

# LIST OF SYMBOLS

**Cd:** coefficient of derivative control

# ABBREVIATIONS

**ADC:** Analog Digital Converter

**ANN:** Artificial Neural Network

**DAC:** Digital Analog Converter

**HVAC:** Heating, Ventilating and Air Conditioning

**NG:** Negative

**PID:** Proportional Integral Derivative

# LIST OF FIGURES

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# INTRODUCTION

Introduction should include the general information about the physics/math/or whatever behind your problem. Statement of the problem and need for the study (What is your motivation for this thesis? Define the problem clearly and give the importance of the problem?). Sub problems (Mention about your secondary motivations)

A sample equation:

|  |  |
| --- | --- |
|  | (1.1) |



Figure 1.1 A sample figure.

Table 1.1 A sample table

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Expression | Values | Description |
| vR | 5268[m/s] | 5268 m/s | Rayleigh wave velocity |
| f0 | 100[MHz] | 1.0000E8 Hz | Target frequency |
| lambda0 | vR/f0 | 5.2680E-5 m | Target wavelength |
| w0 | lambda0/4 | 1.3170E-5 m | Electrode width |
| h0 | 5\*lambda0 | 2.6340E-4 m | Electrode length |
| gap\_port | 10\*lambda0 | 5.2680E-4 m | Horizontal gap between ports |
| gap\_term | lambda0 | 5.2680E-5 m | Vertical gap between terminals |
| N0 | 3 | 3 | Number of electrodes |
| pitch | 4\*w0 | 5.2680E-5 m | Pitch of electrodes |
| gap\_vert | (3+2)\*lambda0 | 2.6340E-4 m | Distance of electrode from substrate wall along vertical direction |
| gap\_horiz | (3+2)\*lambda0 | 2.6340E-4 m | Distance of electrode from substrate wall along horizontal direction |
| t0 | 2\*lambda0 | 1.0536E-4 m | Substrate thickness |
| N\_cyc | 20 | 20 | Number of cycles to simulate |
| h\_max | lambda0/5 | 1.0536E-5 m | Maximum mesh size |
| CFL | 0.2 | 0.2 | CFL number |
| tstep | CFL\*h\_max/vR | 4.0000E-10 s | Maximum solver time step |
| V0 | 10[V] | 10 V | Input voltage magnitude |
| eta0 | 0.001 | 0.001 | Mechanical loss factor |
| pz\_thick | 1 [um] | 1.0000E-6 m | Piezoelectric material thickness |
| gap\_depth | 5 [um] | 5.0000E-6 m | Depth of rectangular gap |

## Thesis Content

The content should include the following sections.

# RESEARCH OBJECTIVE

Introduction (The general information about the physics/math/or whatever behind your problem). Statement of the Problem and Need for the Study (What is your motivation for this thesis? Define the sub-problem clearly and give the importance of the problem?). Sub-problems (Mention about your secondary motivations)

# RELATED LITERATURE

The studies about your thesis, who did try to solve similar problems? What are their results? Which parts of these results are unsatisfactory? The contribution of your study? (May be your study is just a replica of some previous works. Please refer the previous work and just inform the reader about this).

# DESIGN

## Realistic constraints and conditions

In this subsection, you must include factors such as environmental issues, sustainability, manufacturability, ethics, health, safety, and social and political issues, in accordance with the nature of the design.

## Cost of the design

In this subsection, you must include the cost of your design in detail in accordance with the concept of the design. You can provide price of each components that you used in your project.

## Engineering Standards

In this subsection, you must provide and discuss the engineering standards used in your design.

You may find some of sample standards in the following links:

Bluetooth standards: <http://www.informit.com/articles/article.aspx?p=23760&seqNum=3>

Wireless standards:

<https://ieeexplore.ieee.org/browse/standards/get-program/page/series?id=68>

Microprocessor standards: <http://grouper.ieee.org/groups/msc/>

For software standards: <https://webstore.ansi.org/industry/software>

## Details of the design

In this subsection, you must provide a detailed explanation of your design.

# METHODS

Design (implementation/simulation studies), The experimental setups/the algorithms/the HW designs must be mentioned in detail. The logic behind the study must be explained.

# RESULTS AND DISCUSSION

Present the results of your study. Comment about the results: Are they satisfactory enough to solve your problem mentioned in chapter 1? Use these results to comment about your study: Which part of your study is not good enough and why? Discuss the satisfactory/unsatisfactory parts.

# CONCLUSION

Summary of your work: The important points of the study (from each chapter) should be mentioned, your contribution should be emphasized. The important points of the discussion section should be written and related results should be referred.

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# APPENDICES

## Appendix A

**Matlab Code for Numerical Solution of Rayleigh-Lamb Frequency Equations**

clc,clear all

VpMatrix=[0];

i=1;

d = 0.1e-6 % Thickness of the thin AlN plate

h = d/2;

f = 1e8; % Target frequency of SAW device

Vl = 10287.28; % Longitudinal wave velocity

Vs = 5867; % Shear wave or tangential wave velocity

w=2\*pi\*f; % Angular frequency

SignChange=2;

for d = 0.1e-6:1e-6:52.36e-6

h = d/2;

SignChange=2;

for Vp = 1:1:6000; % Phase velocity

k = w/Vp;

p = sqrt((w/Vl)^2-k^2);

q = sqrt((w/Vs)^2-k^2);

% Lamb's equation for antisymmetric modes

lambAsym = real(q\*tan(q\*h) + ((q^2-k^2)^2\*tan(p\*h))/(4\*k^2\*p));

if SignChange~=sign(lambAsym) && sign(lambAsym)~=0 &&...

SignChange ~=2;

SignChange=sign(lambAsym);

disp('kök');

break

end

Vp

if SignChange == 2

SignChange=sign(lambAsym);

end

end

VpMatrix(i)=Vp;

i=i+1;

end

dMatrix = 0.1e-6:1e-6:52.36e-6;

plot(dMatrix,VpMatrix)