A simple AAU Template for a Collection of Papers Ph.D. Thesis

Ph.D. Dissertation

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Dissertation submitted month XX, 20XX

Thesis submitted:	Month XX, 20XX
PhD Supervisor:	Prof. XX
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PhD Committee:	Prof. X, Y University
	Prof. X, Y University
	Prof. X, Y University
PhD Series:	Faculty of X, Aalborg University

ISSN: xxxx-xxxx
ISBN: xxx-xx-xxxx-xxx-x

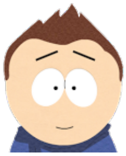
Published by:
Aalborg University Press
Skjernvej 4A, 2nd floor
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

Printed in Denmark by Rosendahls, 20XX

Normalsider: XXX sider (á 2.400 anslag inkl. mellemrum).
Standard pages: XXX pages (2,400 characters incl. spaces).

Curriculum Vitae

Author name



Here is the CV text.

Abstract

English abstract

Resumé

Danish Abstract

Contents

Todo list

Preface

As my background does (did) not lie in mathematics, physics or computer science, which – trust me – were three equally crucial components in creating the result of this project, I added a, say, more pedagogical section at the end of this thesis. These tutorials are a result of the things that I learned and (hopefully) explain topics such as *Energy Analysis*, *Stability Analysis*, etc. in a way so that others with the same background will be able to understand what is going on.

Name
Aalborg University, September 16, 2020

Part I

Introduction

Introduction

1 History of bowed strings

In static bow-string-interaction models, the friction force is defined as a function of the relative velocity between the bow and the string only. The first mathematical description of friction was proposed by Coulomb in 1773 [**?**] to which static friction, or *stiction*, was added by Morin in 1833 [**?**] and viscous friction, or velocity-dependent friction, by Reynolds in 1886 [**?**]. In 1902, Stribeck found a smooth transition between the static and the coulomb part of the friction curve now referred to as the Stribeck effect [**?**]. The latter is still the standard for static friction models today.

2 To do thingies

- Think about how to define real-time.
- Create an intuition for different parts of the equation

2.1 Intuition for the frequency dependent damping term $2\sigma_1\partial_t\partial_x^2 u$

Take the frequency independent damping term $-2\sigma_0\partial_t u$. The more positive the velocity $\partial_t u$ is, i.e., the string is moving upwards the more this term applies a negative, or downwards force (/effect) on the string. Vice versa, a more negative velocity will make this term apply a more positive force on the string. As for the frequency dependent damping term, apart from the obvious σ_1, the effect of the term increases with an increase of $\partial_t\partial_x^2 u$ which describes the rate of change of the curvature of the string.

Let's first talk about positive and negative curvature, i.e., when $\partial_x^2 u > 0$ or $\partial_x^2 u < 0$. Counterintuitively, in the positive case, the curve points downwards. Think about the function $f(x) = x^2$. It has a positive curvature (at any point), but has a minimum. We can prove this by taking $x = 0$ and setting grid spacing $h = 1$.

$$\begin{aligned}\delta_{xx} f(x) &= \frac{1}{h^2}\left(f(-1) - 2f(0) + f(1)\right), \\ &= \frac{1}{1^2}\left((-1)^2 - 2\cdot 0^2 + 1^2\right), \\ &= (1 - 0 + 1) = 2.\end{aligned} \tag{1}$$

In other words, the second derivative of the function $f(x) = x^2$ around $x = 0$ is positive.

As our term does not only include a second-order spatial derivative but also a first-order time derivative, we are now talking about a positive or negative *rate of change* of the curvature, i.e., when $\partial_t \partial_x^2 u > 0$ or $\partial_t \partial_x^2 u < 0$. A positive rate of change of curvature means that the string either has a positive curvature and is getting more positive, i.e., the string gets more curved over time, or that the string has a negative curvature and is getting less negative, i.e., the string gets less curved or 'loosens up' over time. In the same way, a negative rate of change of curvature means that the string either has a negative curvature and is getting more negative, or that the string has a positive curvature and is getting less positive.

Let's see some examples. Take the same function described before, but now f changes over time, fx. $f(x,t) = tx^2$. When t increases over time, the curvature gets bigger. Repeating what we did above with $x = 0$ and grid spacing $h = 1$, but now with $t = 2$ and step size $k = 1$, but now with a backwards time derivative we get:

$$\begin{aligned}\delta_{t-}\delta_{xx} f(x,t) = \frac{1}{kh^2}\Bigg(&\ f(-1,2) - 2f(0,2) + f(1,2) \\ &- \Big(f(-1,1) - 2f(0,1) + f(1,1)\Big)\Bigg), \\ = \frac{1}{1\cdot 1^2}\Bigg(&2\cdot(-1)^2 - 2\cdot 2\cdot (0)^2 + 2\cdot 1^2 \\ &- \Big(1\cdot(-1)^2 - 2\cdot 1\cdot (0) + 1\cdot (1^2)\Big)\Bigg), \\ = 2 + 2 - &(1+1) = 2.\end{aligned}$$

So the rate of change of the curvature is positive, i.e., the already positively curved function x^2 gets more curved over time.

If the curvature around a point along a string gets more positive (or less negative) over time, the force applied to that point will be positive. Vice versa, if the curvature around a point along a string gets more negative (or less positive) over time, the force applied will be negative.

The fact the frequency dependent term to be added rather than subtracted to the FDS, is caused by the fact that a positive curvature implies a negative position in the string (think of the function x^2 which has a positive curvature, but the function 'points' downwards). This translated to the force/effect this term has on the scheme means...

3 Notes

One over number $\rightarrow$ reciprocal of number

Example: When the waveform consists entirely of harmonically related frequencies, it will be periodic, with a period equal to the reciprocal of the fundamental frequency (from An Introduction to the Mathematics of Digital Signal Processing Pt 2 by F. R. Moore)

References

References

Part II

Models

Models

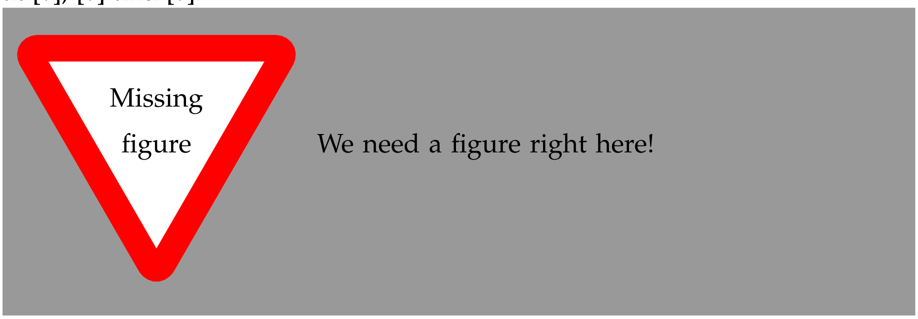
4 Bow Models

As opposed to less complex bow models, such as the hyperbolic [source] and exponential [source] models, the elasto-plastic bow model assumes that the friction between the bow and the string is caused by a large quantity of bristles, each of which contributes to the total amount of friction.

5 Section 2 name

Here is section 2. If you want to leearn more about LaTeX 2_ε, have a look at [?], [?] and [?].

I think this word is mis-pelled



5.1 Examples

You can also have examples in your document such as in example **??**.

Example 5.1 (An Example of an Example)
Here is an example with some math

$$0 = \exp(i\pi) + 1\ . \tag{2}$$

You can adjust the colour and the line width in the `macros.tex` file.

5.2 How does Subsections and Subsubsections Look?

Well, like this

This is a Subsubsection

and this.

A Paragraph You can also use paragraph titles which look like this.

A Subparagraph Moreover, you can also use subparagraph titles which look like this. They have a small indentation as opposed to the paragraph titles.

Is it possible to add a subsubparagraph?

I think that a summary of this exciting chapter should be added.

6 Conclusion

In case you have questions, comments, suggestions or have found a bug, please do not hesitate to contact me. You can find my contact details below.

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http://sqrt-1.dk
Audio Analysis Lab, CREATE
Aalborg University
Denmark

References

[1] L. Madsen, "Introduktion til LaTeX," http://www.imf.au.dk/system/latex/bog/, 2010.

[2] F. Mittelbach, *The LATEX companion*, 2nd ed. Addison-Wesley, 2005.

[3] T. Oetiker, "The not so short a introduction to LaTeX2e," http://tobi.oetiker.ch/lshort/lshort.pdf, 2010.

Part III

Papers

Paper A

Paper A title

List of authors

The paper has been published in the
Journal or Proceedings Vol. XX(X), pp. XXX–XXX, 201X.

Abstract

Here is an abstract.

1 Introduction

Here is an introduction [**?**].

2 Conclusion

Here is the conclusion.

A An appendix

Here is some text.

References

[1] F. Mittelbach, *The LATEX companion*, 2nd ed. Addison-Wesley, 2005.

Paper B

Paper B title

List of authors

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1 Introduction

Here is an introduction [**?**].

2 Conclusion

Here is the conclusion.

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[1] F. Mittelbach, *The LATEX companion*, 2nd ed. Addison-Wesley, 2005.