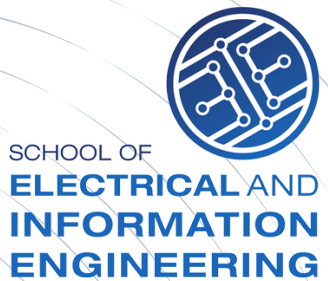
Listen to your Heart:
Heartbeat Sound Segmentation & Classification

September 11, 2019

Boikanyo Radiokana & Elias Sepuru

School of Electrical & Information Engineering
University of the Witwatersrand
South Africa

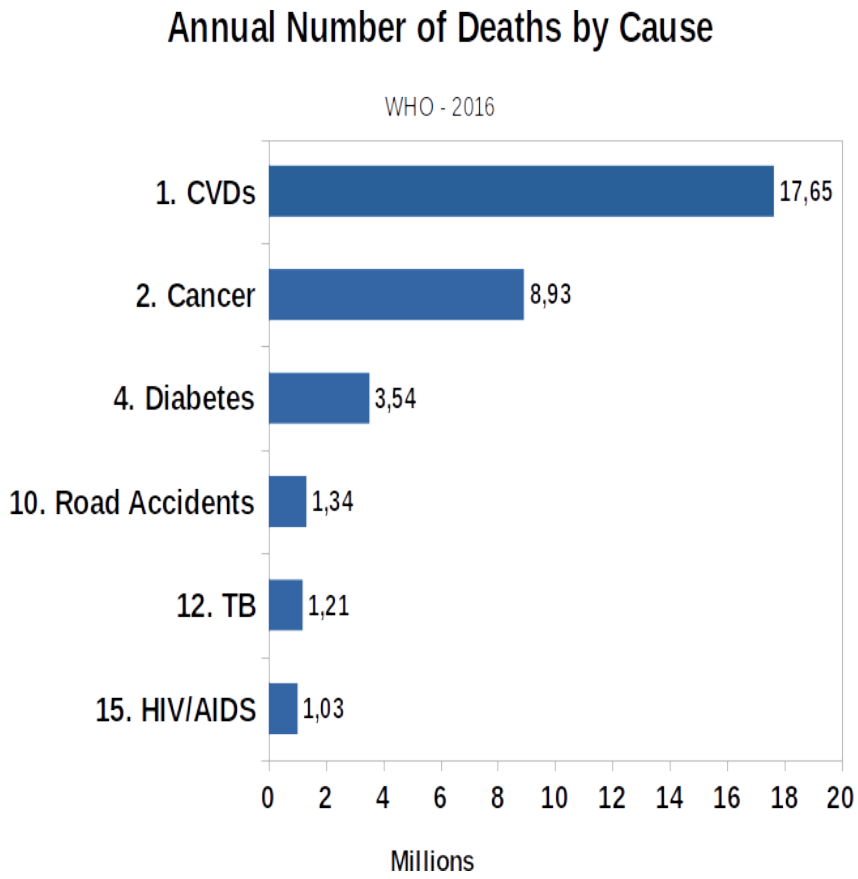


Agenda

- Introduction
- Objectives
- Background
  - Heartbeat Sounds Categories
  - Related Work
  - Modifying the theme
  - AAU Waves
  - Widescreen Support
- Feedback
  - Known Problems
  - Bugs, Comments and Suggestions
  - Contact Information

Introduction

- CVDs are the leading causes of death globally - WHO.



Introduction

- CVDs are the leading causes of death globally - WHO.
- Currently used method to check for CVDs is Cardiac Auscultation (CA).

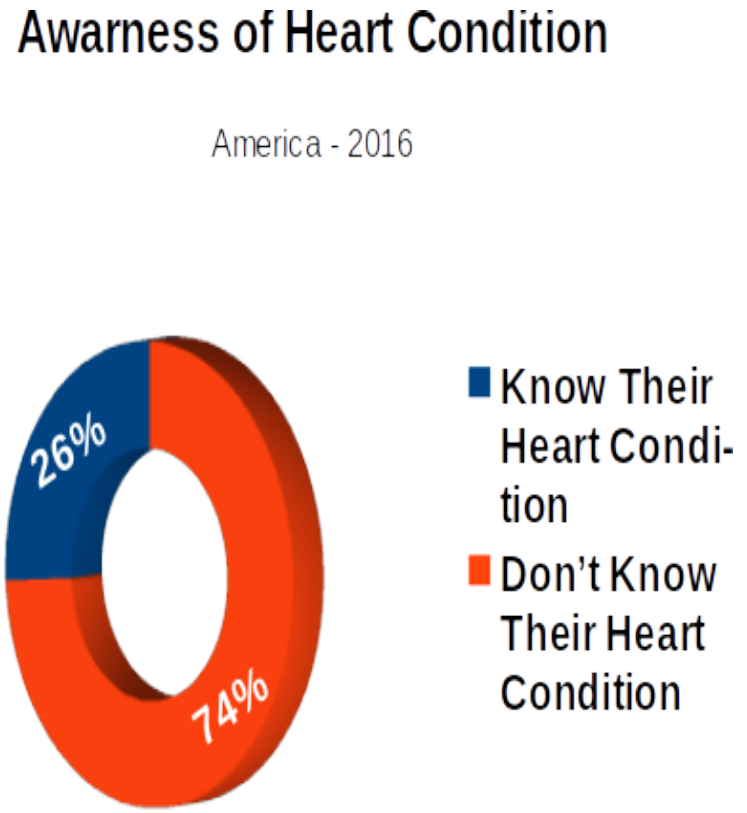
Introduction

- CVDs are the leading causes of death globally - WHO.
- Currently used method to check for CVDs is Cardiac Auscultation (CA).
- CA is a difficult skill to acquire.

Correct diagnosis using CA in USA, Canada & UK respectively.

Introduction

- CVDs are the leading causes of death globally - WHO.
- Currently used method to check for CVDs is Cardiac Auscultation (CA).
- CA is a difficult skill to acquire.
- People are not aware of their heart conditions.

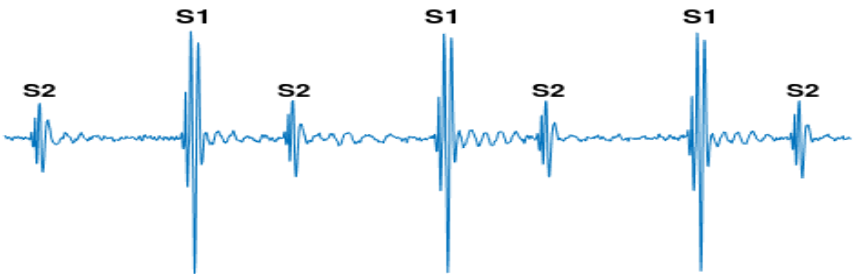


Introduction

Easily accessible & reliable heart diagnosis systems would help reduce deaths due to CVDs.

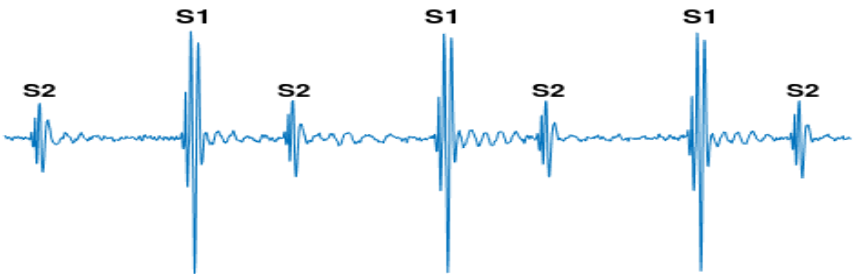
Objectives

- To segment Heartbeat sounds (HSs) based on the location of S1 (lub) S2 (dub) in Normal HSs.

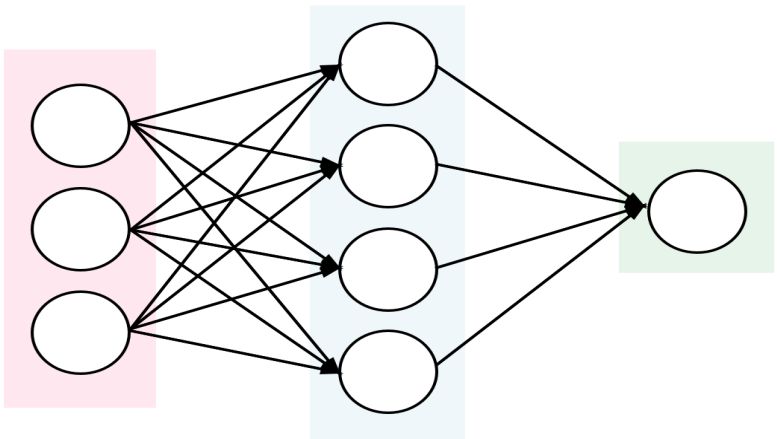


Objectives

- To segment Heartbeat sounds (HSs) based on the location of S1 (lub) S2 (dub) in Normal HSs.



- Create models that will enable preliminary screening of CVDs



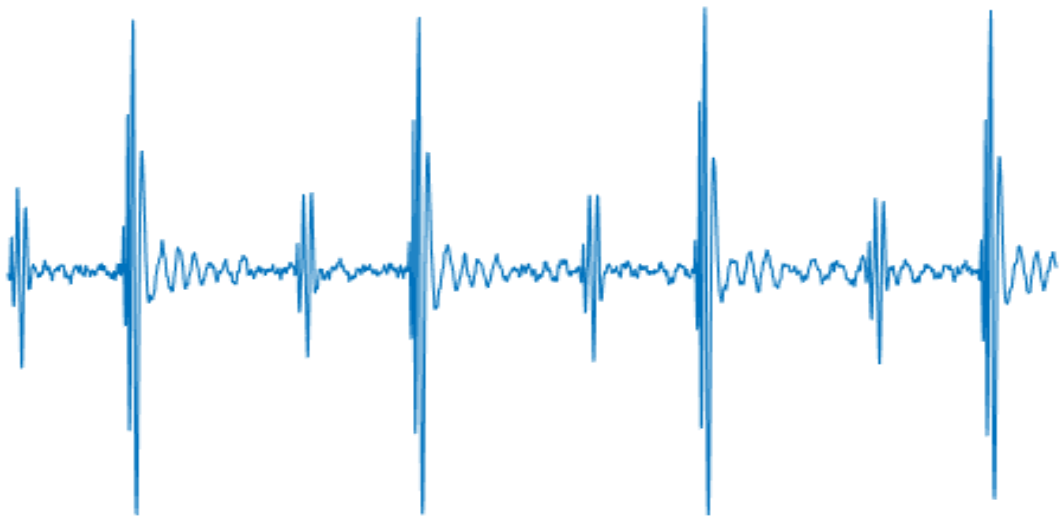
Background
Heartbeat Sounds Categories

This project deals with classifying HSs into the following categories:

1. Normal HSs
2. Murmur HSs
3. Extra Heartsounds
4. Exrasystole HSs
5. Artifact

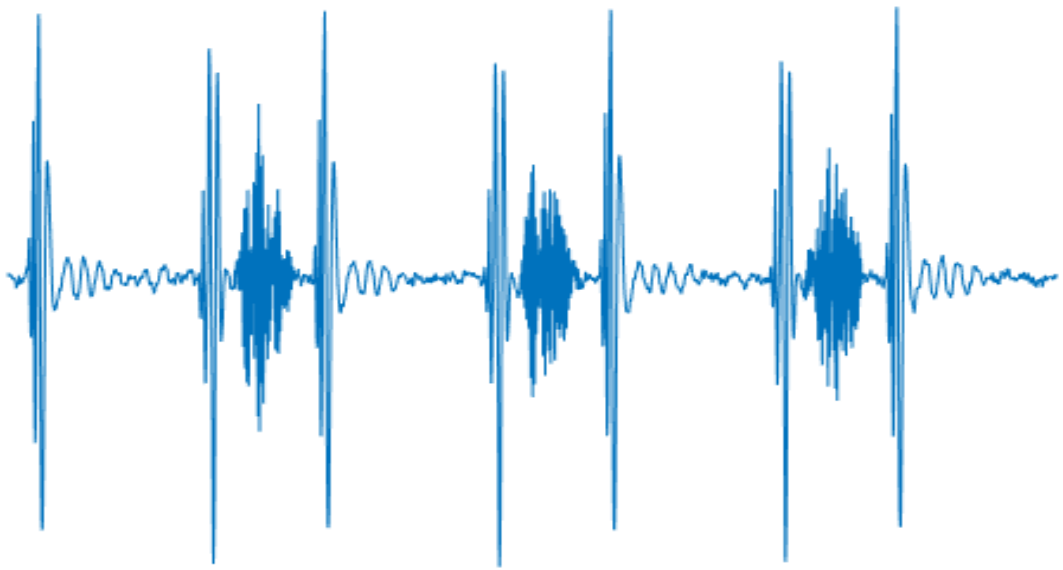
Normal HSs

lub...dub.....lub...dub.....



Murmur HSs

```
lub..***..dub......lub..***..dub......
                or
lub....dub...******...lub....dub...******...
```

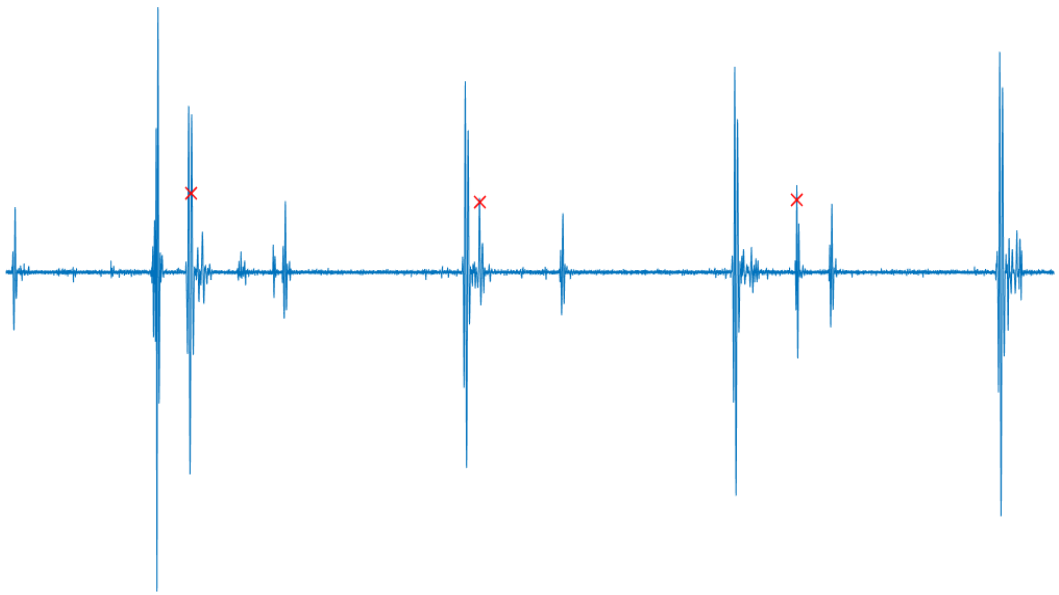


Extra HS

lub.lub...dub.....lub.lub...dub.....

or

lub...dub.dub.....lub...dub.dub.....

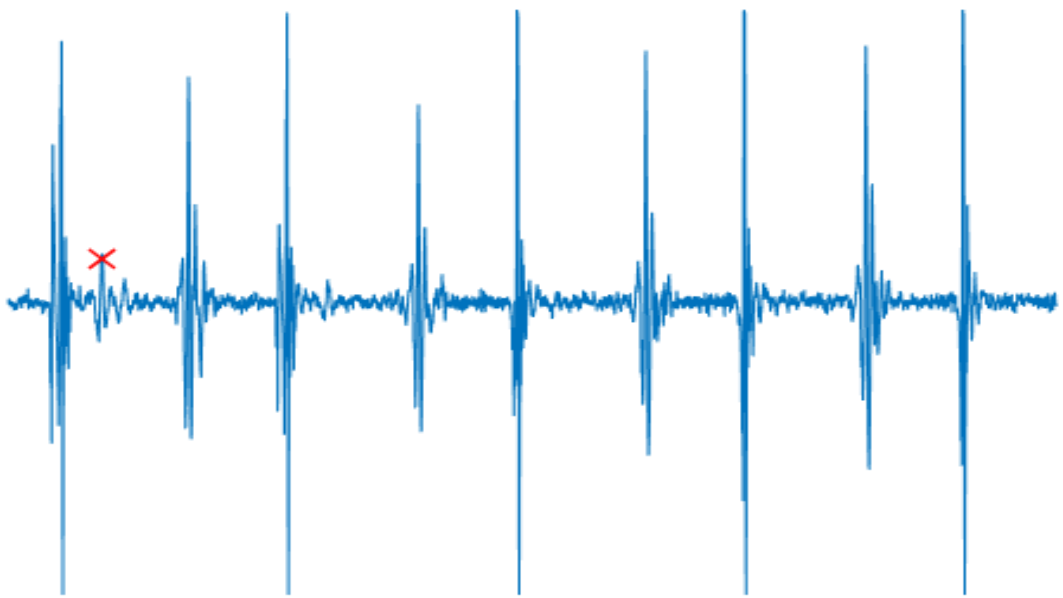


Extrasytole HSs

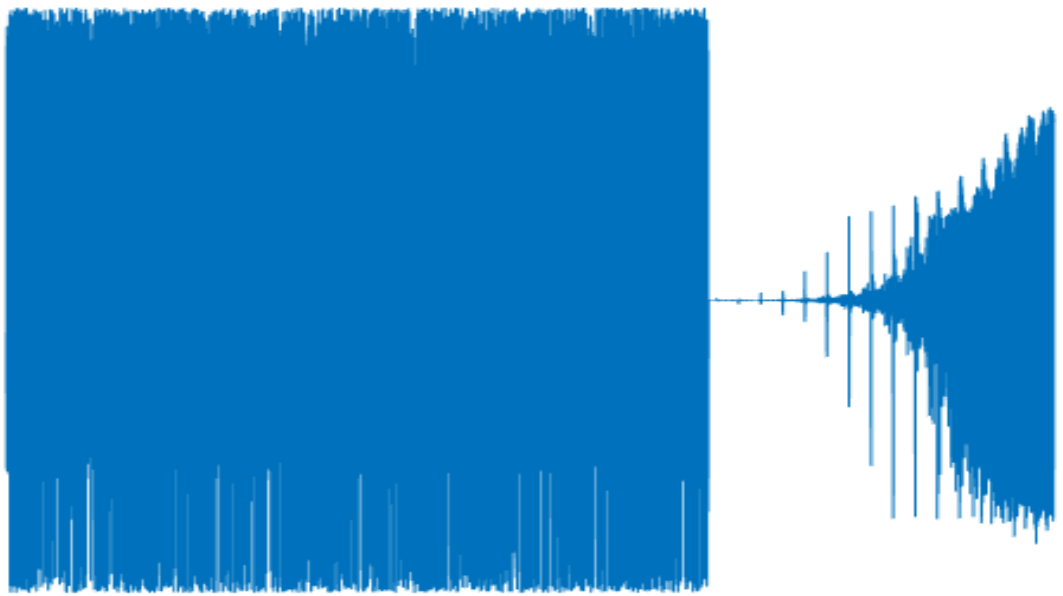
lub....dub.....lub.lub...dub.....lub....

or

lub....dub.dub.....lub...dub.....lub....



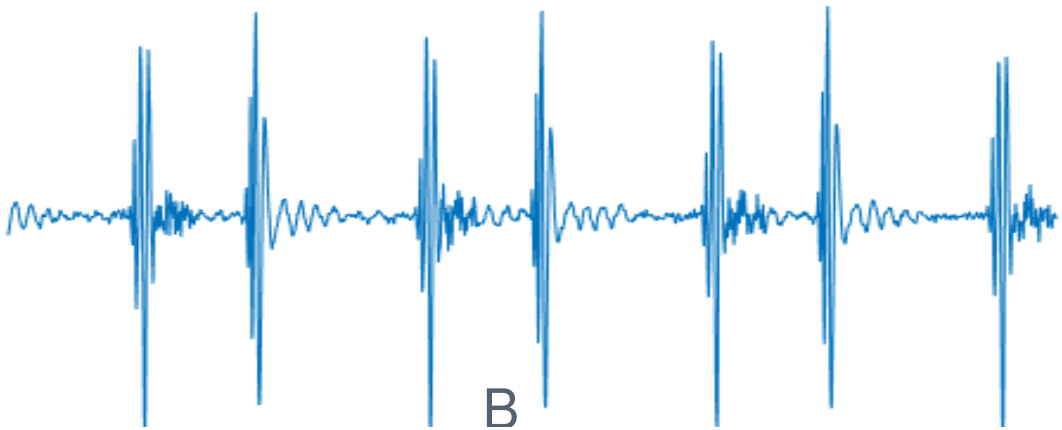
Artifact Sound
Not an actual HSs.



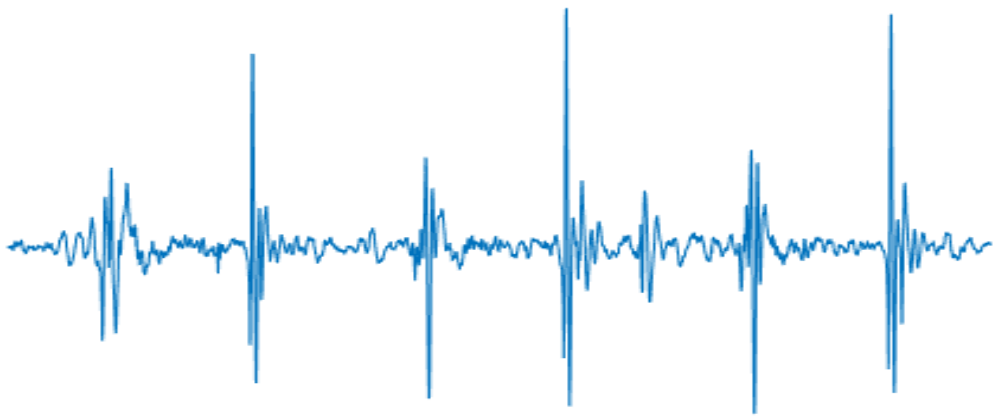
Background
Heartbeat Sounds Categories

Can you guess the categories?

A



B



Background
Related Work

Strunic's attempt to classify HSs with ANN.

85±7.4%

Accuracy when classifying simulated HSs with no noise.

48±12.7%

Accuracy when classifying real life HSs with noise.

The Outer Theme

You can load the outer theme directly by

```
\useoutertheme[<options>]{AAUsimple}
```

Currently, the theme options are

- `progressstyle={fixedCircCnt, movCircCnt, or corner}`: set how the progress is illustrated. The value `fixedCircCnt` is the default.
- `rotationcw`: set the direction of the rotation of the progress circle to clockwise instead of counterclockwise. This option has only effect for the circular progress bars.
- `shownavsym`: show the navigation symbols

The Color Theme

You can load the color theme directly by

```
\usecolortheme{AAUsimple}
```

and it has no options.

The Color Theme

You can load the color theme directly by
`\usecolortheme{AAUsimple}`
and it has no options.

The Color Element `AAUsimple`

The color theme defines a new beamer color element named `AAUsimple` whose foreground and background colors are

- fg: light blue ({RGB}{194,193,204})
- bg: dark blue ({RGB}{33,26,82})

You can use these colors in the standard beamer way by using the command `\usebeamercolor[<fg or bg>]{AAUsimple}`. See the beamer manual for instructions.

The Color Theme

You can load the color theme directly by
`\usecolortheme{AAUsimple}`
and it has no options.

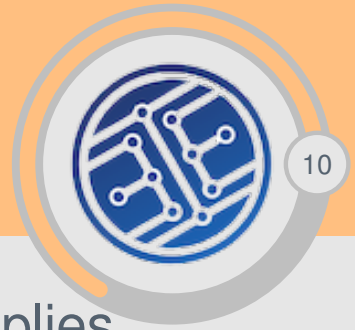
The Color Element `AAUsimple`

The color theme defines a new beamer color element named `AAUsimple` whose foreground and background colors are

- fg: light blue ({RGB}{194,193,204})
- bg: dark blue ({RGB}{33,26,82})

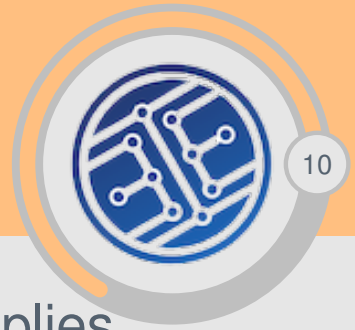
You can use these colors in the standard beamer way by using the command `\usebeamercolor[<fg or bg>]{AAUsimple}`. See the beamer manual for instructions.
Note that this version of the theme is an official AAU version and is in accordance with the AAU design guide. However, you can easily change it (including the colour of the logo) by following the steps in `beamercolorthemeAAUsimple.sty`.

User Interface
Modifying the Theme



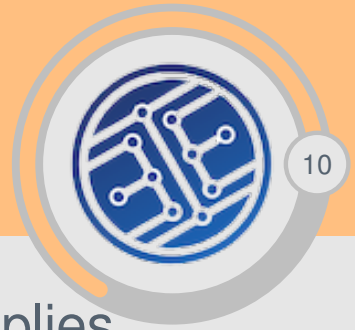
- The default configuration of fonts, colors, and layout complies with the AAU design guidelines and is the official version of the theme.

User Interface
Modifying the Theme



- The default configuration of fonts, colors, and layout complies with the AAU design guidelines and is the official version of the theme.
- However, you can modify specific elements of the theme through the templates provided by the beamer class. Please refer to the beamer user manual for instructions.

User Interface
Modifying the Theme



- The default configuration of fonts, colors, and layout complies with the AAU design guidelines and is the official version of the theme.
- However, you can modify specific elements of the theme through the templates provided by the beamer class. Please refer to the beamer user manual for instructions.
- For example, on this slide the following commands have been used
  - Change the header colours:
    `\setbeamercolor{AAUsimple}{fg=blue!20,bg=red!50}`
  - Change the color of the structural elements:
    `\setbeamercolor{structure}{fg=black}`
  - Change the frame title text color:
    `\setbeamercolor{frametitle}{use=structure, fg=structure.fg}`
  - Change the background color of the text `\setbeamercolor{normal text}{bg=gray!20}`

The AAU Waves Background Image

- In this documentation, the title page frame and the last frame have the AAU waves as the background image. The AAU waves background image can be added to any single frame by wrapping a frame in the following way

```
{\aauwavesbg
\begin{frame}[<options>]{Frame Title}{Frame Subtitle}
...
\end{frame}}
```

The AAU Waves Background Image

- In this documentation, the title page frame and the last frame have the AAU waves as the background image. The AAU waves background image can be added to any single frame by wrapping a frame in the following way

```
{\aauwavesbg
\begin{frame}[<options>]{Frame Title}{Frame Subtitle}
...
\end{frame}}
```

- Ideally, I would like to create a new frame option called `aauwavesbg` which can enable the AAU waves background. However, I have not been able to figure out how such an option can be added. If you know how this can be done, please contact me.

Widescreen Support

Newer projectors and almost any modern TV support a widescreen format such as 16:10 or 16:9. Beamer (>= v. 3.10) supports various aspect ratios of the slides. According to section 8.3 on page 77 of the Beamer user guide v. 3.10, you can write

```
\documentclass[aspectratio=1610]{beamer}
```

to get slides with an aspect ratio of 16:10. You can also use 169, 149, 54, 43 (default), and 32 to get other aspect ratios.

Feedback
Known Problems

More than 50 slides Internally, TeX cannot work with numbers exceeding +/-16

Feedback
Bugs, Comments and Suggestions

- There are probably still some bugs in the theme. If you should find one, then please let me know. No bug is too small!

Feedback
Bugs, Comments and Suggestions

- There are probably still some bugs in the theme. If you should find one, then please let me know. No bug is too small!
- Also, please contact me, if you have some exciting new ideas or just some simple usability improvements.

Feedback
Contact Information

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

Boikanyo Radiokana & Elias Sepuru
http://kom.aau.dk/~jkn
Niels Jernes Vej 12, A6-309
9220 Aalborg Ø

Thank you for using this theme!

SCHOOL OF
ELECTRICAL AND
INFORMATION
ENGINEERING