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# **GPS receiver based radiometer design**

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Report submitted in partial fulfilment of the requirements of the module  
Project (E) 448 for the degree Baccalaureus in Engineering in the Department of  
Electrical and Electronic Engineering at Stellenbosch University.

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August 16, 2020

# Acknowledgements

I would like to thank my dog, Muffin. I also would like to thank the inventor of the incubator; without him/her, I would not be here. Finally, I would like to thank Dr Herman Kamper for this amazing report template.



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# Abstract

## **English**

The English abstract.

## **Afrikaans**

Die Afrikaanse uittreksel.

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# Nomenclature

## Variables and functions

$p(x)$	Probability density function with respect to variable $x$ .
$P(A)$	Probability of event $A$ occurring.
$\varepsilon$	The Bayes error.
$\varepsilon_u$	The Bhattacharyya bound.
$B$	The Bhattacharyya distance.
$s$	An HMM state. A subscript is used to refer to a particular state, e.g. $s_i$ refers to the $i^{\text{th}}$ state of an HMM.
$\mathbf{S}$	A set of HMM states.
$\mathbf{F}$	A set of frames.
$\mathbf{o}_f$	Observation (feature) vector associated with frame $f$ .
$\gamma_s(\mathbf{o}_f)$	A posteriori probability of the observation vector $\mathbf{o}_f$ being generated by HMM state $s$ .
$\mu$	Statistical mean vector.
$\Sigma$	Statistical covariance matrix.
$L(\mathbf{S})$	Log likelihood of the set of HMM states $\mathbf{S}$ generating the training set observation vectors assigned to the states in that set.
$\mathcal{N}(\mathbf{x} \mu, \Sigma)$	Multivariate Gaussian PDF with mean $\mu$ and covariance matrix $\Sigma$ .
$a_{ij}$	The probability of a transition from HMM state $s_i$ to state $s_j$ .
$N$	Total number of frames or number of tokens, depending on the context.
$D$	Number of deletion errors.
$I$	Number of insertion errors.
$S$	Number of substitution errors.



## **Acronyms and abbreviations**

AE	Afrikaans English
AID	accent identification
ASR	automatic speech recognition
AST	African Speech Technology
CE	Cape Flats English
DCD	dialect-context-dependent
DNN	deep neural network
G2P	grapheme-to-phoneme
GMM	Gaussian mixture model
HMM	hidden Markov model
HTK	Hidden Markov Model Toolkit
IE	Indian South African English
IPA	International Phonetic Alphabet
LM	language model
LMS	language model scaling factor
MFCC	Mel-frequency cepstral coefficient
MLLR	maximum likelihood linear regression
OOV	out-of-vocabulary
PD	pronunciation dictionary
PDF	probability density function
SAE	South African English
SAMPA	Speech Assessment Methods Phonetic Alphabet

# Chapter 1

## Introduction

GPS receiver chips are very cheap RF receivers with remarkable capability. This project will re-purpose such a receiver chip to be used as a simple total power radiometer. In the simplest version, the system will just output voltage as a function of input power, but more complex systems can easily be developed here with additional functionality (including calibration which should improve the resolution dramatically). The project will benefit from some knowledge of high frequency systems, and will also involve some microcontroller (and possibly FPGA) programming.

### 1.1. Section heading

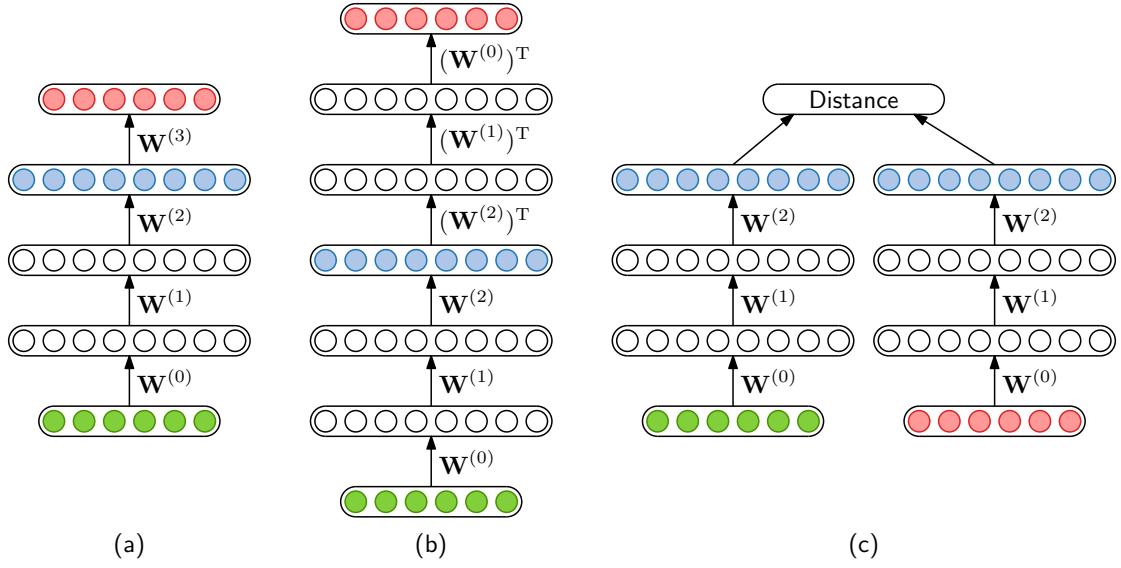
This is some section with two table in it: Table 1.1 and Table 1.2.

**Table 1.1:** Performance of the unconstrained segmental Bayesian model on TIDigits1 over iterations in which the reference set is refined.

Metric	1	2	3	4	5
WER (%)	35.4	23.5	21.5	21.2	22.9
Average cluster purity (%)	86.5	89.7	89.2	88.5	86.6
Word boundary $F$ -score (%)	70.6	72.2	71.8	70.9	69.4
Clusters covering 90% of data	20	13	13	13	13

**Table 1.2:** A table with an example of using multiple columns.

Model	Accuracy (%)		
	Intermediate	Output	Bitrate
Baseline	27.5	26.4	116
VQ-VAE	26.0	22.1	190
CatVAE	28.7	24.3	215



**Figure 1.1:** (a) The cAE as used in this chapter. The encoding layer (blue) is chosen based on performance on a development set. (b) The cAE with symmetrical tied weights. The encoding from the middle layer (blue) is always used. (c) The siamese DNN. The cosine distance between aligned frames (green and red) is either minimized or maximized depending on whether the frames belong to the same (discovered) word or not.

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## **Chapter 2**

### **Summary and Conclusion**

# Bibliography

# **Appendix A**

## **Project Planning Schedule**

This is an appendix.

# **Appendix B**

## **Outcomes Compliance**

This is another appendix.