I don’t know how to start this shit, yo.. now

Summary

Write your summary here...

Preface

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Abbreviations

ANN	=	*Artificial* Neural Network
RC	=	Reservoir Computing

Chapter 1

Introduction

In the 50's and 60's there was much optimism in the burgeoning field of artificial intelligence. In 1965 H. A. Simon claimed "machines will be capable, within twenty years, of doing any work a man can do.", while Marvin Minsky boldly claimed in 1967 that "Within a generation ... the problem of creating 'artificial intelligence' will substantially be solved.". While these claims seem ridiculous in light of todays world, it is easy to understand where this optimism was coming from. Already the computer was capable of superhuman feats, such as multiplying millions of integers in mere seconds, and transistor counts per area had been doubling every 18 months, showing now signs of slowing down. In modern times machines are still far away from being able to perform the tasks which according to H. A. Simon they were supposed to have surpassed us at over 20 years ago. What's worse, the traditional Von-Neumann computer architecture which has been ubiquitus in the field of computer architecture is facing serious issues endangering the exponential growth processors have enjoyed since the 50s. HiPEAC 2015 (ref needed) identifies four key challenges for the future of computer architecture design.

- dependability by design
- managing system complexity
- energy efficiency
- entanglement between physical and virtual world

Even with the assumption that moores law will hold in the future these issues are threatening to drastically reduce future gains in processor speeds, necessitating looking beyond the traditional Von-Neumann architecture. In nature a completely different approach is followed, elegantly sidestepping all four issues. The human brain is highly robust, lacking any single point of failure. It sidesteps the complexity issue by being fully self organized, and operates at around 20 Watts. On the fourth issue neurons double as sensors, giving us our sense of sense and smell elegantly sidestepping the problem of interfacing between processing and sensing.

One effort to study the capabilities of neurons is the NTNU cyborg project, consisting of several departments at NTNU including the department of biotechnology, computer and information science, engineering cybernetics, neuroscience and more. [5] The stated goal for the cyborg project is to enable communication between living nerve tissue and a robot. The social and interactive cyborg will walk around the campus raising awareness for biotechnology and ICT, bringing NTNU in the forefront of research and creating a platform for interdisciplinary collaborations and teaching. This thesis is structured as follows: First covers biological neural networks from a computational standpoint and the technique, *reservoir computing* used to harness their computational power.
Next the system that has been implemented is covered, divided into three parts for each of the three subsystems MEAME-DSP, MEAME and SHODAN.
The third part covers the experiment setup and explores the results obtained so far, as well as discussing further work.

Chapter 2

Background

Chapter 3

System Overview

This chapter provides an overview of the components comprising the final system. fig??? shows an idealized version of the cyborg which remains the core focus of the system. In this ideal cyborg an interface connects the biological nerual network to an ANN readout layer, which in turn controls a robot whose input is processed and relayed back to the neural network. With this guiding principle the final system has been designed with the following components.

Core Reservoir Interface
: Responsible for providing a bdirectional bridge between the reservoir and the outside world.

Data Processing
: Processes the signals from the biological neural network, as well as the sensory input from the robot to a neuro-compatible format.

Agent Control
: Embodies the biological neural network in a robot, either artificial or real.

These components are enough to satisfy the ideal version of the cyborg, but for a cyborg to function in a practical setting additional components are necessary:

Communication
: While the Core Reservoir Interface provides a bidirectional bridge, it is the Communications module that extends that bridge to any machine connected to a network.

Recording
: Data from reservoirs is stored in a database, making experiment data accessible to any computer connected to the network.

Online Reconfiguration
: The Online Reconfiguration module is responsible for providing the cyborg with a filter that interprets the data from the biological neural network which is achieved by reconfiguring the filter when the system is running to adapt to the current reservoir.

Together these components form a system, whose architecture shown in fig. ??? looks quite different from the ideal cyborg.

3.1 A Closed Loop Example

The final architecture is quite extensive compared to the ideal version, but it still exists to provide a closed loop embodiment of the neural network. To give an idea of how the system is used it is necessary with an example run.

Setup The user accesses a web interface provided by the main server (SHODAN) and configures the experiment. This entails setting up a database recording, selecting filter and parameters and selecting what sort of agent should be running.

Launch Once the experiment is configured the main server contacts the lab computer (MEAME) and requests data acquisition to start. MEAME creates a TCP socket which holds the data read from the reservoir.

Execution After setup is done the

Appendix

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