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Interferometric stabilisation of a fibre-based optical computer

Experimental study

Mémoire présenté en vue de l'obtention du diplôme
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Abstract

Acknowledgements

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Chapter 1

Introduction

For the past few years, interest in optical data processing devices has been increasing. Their main advantage over silicon-based computers is that they are intrinsically faster because the information is carried around at nearly the speed of light, which could allow to overcome the limit in processing speed soon to be reached by classical integrated circuit electronics.

This Master thesis tackles the implementation of an optical computer based on reservoir computing.

Chapter 2

Reservoir Computing

2.1 Introduction

Reservoir Computing (RC) is a bio-inspired artificial recurrent neural network which is based on the Echo State Network (ESN) paradigm introduced by Herbert Jaeger in [3]. This computation scheme is well suited for real-time data processing and for chaotic time series prediction[3, 4, 6], and achieves state of the art performances in those domains, as well as in speech recognition[9, 8, 5], nonlinear channel equalisation[3] and financial forecasting [1].

A Reservoir Computer (RC) is made of a large ensemble of interconnected neurons, which are merely entities carrying an activation level. The activation level is updated according to the connection weights of the reservoir, or *synaptic matrix* as it is referred to in the field of neural networks, and with a nonlinear function, called the *activation function*. The nonlinear character is one of the main features making neural networks so powerful. Moreover, with a proper activation function, one can reach a saturation state, which mimics the behaviour of biological neurons. This is traditionally achieved using the *sigmoid* function. Those principles are introduced in [2, p.227-228] and in [7, p.727-728].

Chapter 3

Optical Reservoir Computer with frequency multiplexed neurons

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Acronyms

ESN Echo State Network 7

RC Reservoir Computer 7

RC Reservoir Computing 7

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