

INSTITUTO TECNOLÓGICO Y DE ESTUDIOS SUPERIORES DE
MONTERREY
CAMPUS MONTERREY



REAL-TIME MONITORING AND DIAGNOSIS IN DYNAMIC SYSTEMS
USING PARTICLE FILTERING METHODS

BY

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I would like to thank ...

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Thank..

Dedication

To ...

To ...

Abstract

Fault diagnosis is ...

Contents

1	Introduction	1
1.1	Motivation	1
1.2	Problem description	1
1.3	State-of-the-art	1
1.4	Related work	1
1.5	Contributions	1
1.6	Outline	1
2	State of the Art	2
3	PROPOSAL	3
3.1	Introduction	3
3.2	Research proposal	3
3.3	Design of Experiments	3
3.4	Conclusions	3
4	Conclusions	4
4.1	Results	4
4.2	Contributions	4
4.3	Limitations	4
A	Appendix 1	6
B	Diagnosis in Dynamic Systems	7
B.1	Definitions	7
B.2	The Qualitative Model Representation	7

List of Tables

List of Figures

Chapter 1

Introduction

Locate the reader on the specific topic

1.1 Motivation

Why is this work important? What is the relevance practice ? Who might be interested in reading this work?

Example of citation [Meir, 1995]

1.2 Problem description

What is the problem that is going to be solved? Size the problem and limit the problem.

1.3 State-of-the-art

Briefly describe who and how they have attacked the problem. This will be detailed in detail in chapter 2

1.4 Related work

Very briefly describe who similarly (if this is the case) to what you are going to propose.

1.5 Contributions

Highlight what were the 3 main contributions of your research project

1.6 Outline

Describe how the thesis document is structured. If there are 5 chapters: In chapter 1 you see..., in chapter 2, is analyzed..., the bibliography. The appendices are organized in... Appendix 1 deals with....

Chapter 2

State of the Art

More citations [de Freitas, 1997]. More citations [Girosi *et al.*, 1995]

Chapter 3

PROPOSAL

3.1 Introduction

3.2 Research proposal

3.3 Design of Experiments

3.4 Conclusions

Chapter 4

Conclusions

4.1 Results

Main results appear in [de Freitas *et al.*, 2004].

4.2 Contributions

4.3 Limitations

Bibliography

- [de Freitas *et al.*, 2004] Nando de Freitas, R. Dearden, F. Hutter, R. Morales-Menendez, J. Mutch, and D. Poole. Diagnosis by a Waiter and a Mars Explorer. *Proc of the IEEE*, 92(3):455–468, 2004.
- [de Freitas, 1997] N de Freitas. Neural network based nonparametric regression for nonlinear system identification and fault detection. Master’s thesis, University of the Witwatersrand, Johannesburg, 1997.
- [Girosi *et al.*, 1995] F Girosi, M Jones, and T Poggio. Regularization theory and neural networks architectures. *Neural Computation*, 7(2):219–269, 1995.
- [Meir, 1995] R Meir. Bias, variance and the combination of estimators: The case of linear least squares. Technical report, Department of Electrical Engineering, Technion, Haifa, Israel, 1995.
- [Moody, 1992] J E Moody. The effective number of parameters: An analysis of generalization and regularization in nonlinear learning systems. In J E Moody, S J Hanson, and R P Lippmann, editors, *Advances in Neural Information Processing Systems 4*, 1992.
- [Sjöberg, 1995] J Sjöberg. *Non-Linear System Identification with Neural Networks*. PhD thesis, Department of Electrical Engineering, Linköping University, Sweden, 1995.

Appendix A

Appendix 1

Uso de referencias [Moody, 1992] and [Sjöberg, 1995]

Appendix B

Diagnosis in Dynamic Systems

B.1 Definitions

Some important definitions in dynamic systems are:

1. *Static versus dynamic systems.*
A system is
2. *Linear versus non-linear models.*
A linear model,

B.2 The Qualitative Model Representation

Curriculum Vitae

Rubén Morales-Menéndez was born in Veracruz, México. He received the degree of Bachelor of Science in Chemical Engineering and Systems (1984), the degree of Master of Science in Chemical Engineering (1986) and the degree of Master of Science in Control Engineering (1992) from Tecnológico de Monterrey, Campus Monterrey, México, where he is currently a full professor in the Mechatronics and Automation Dept. He is also a consultant specializing in the analysis and design of automatic control systems for continuous processes, and a PhD candidate. From 2000 through 2003 he has been a visiting scholar at the Laboratory of Intelligence Computer. of the University of British Columbia, Canada. His research interests include artificial intelligence techniques for control processes.