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Escola de Engenharia  
Programa de Pós-Graduação em Engenharia Elétrica  
Laboratório de Modelagem, Análise e Controle de Sistemas Não-Lineares

# SENSOR FUSION FOR IRREGULAR SAMPLED SYSTEMS

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Dissertação apresentada ao Programa de Pós-Graduação em Engenharia Elétrica da Universidade Federal de Minas Gerais como requisito parcial para a obtenção do grau de Mestre em Engenharia Elétrica

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## Contents

|          |  |          |
|----------|--|----------|
| <b>1</b> | <b>Introduction . . . . .</b>                                      | <b>2</b> |
| 1.1      | <i>Motivations . . . . .</i>                                       | 2        |
| 1.2      | <i>Problem Formulation . . . . .</i>                               | 2        |
| 1.3      | <i>Objectives . . . . .</i>  | 2        |
| 1.4      | <i>Thesis Structure . . . . .</i>                                  | 2        |
| <b>2</b> | <b>Literature Review . . . . .</b>                                 | <b>3</b> |
| 2.1      | <i>Multi-Sensor Sytems . . . . .</i>                               | 3        |
| 2.2      | <i>Irregular Sampled Systems . . . . .</i>                         | 3        |
| 2.3      | <i>State Estimation Under Irregular Sampling . . . . .</i>         | 3        |
| 2.3.1    | Known Measurement Instance . . . . .                               | 3        |
| 2.3.2    | Unknown Measurement Instance . . . . .                             | 3        |
| <b>3</b> | <b>Material and Methods . . . . .</b>                              | <b>4</b> |
| 3.1      | <i>Unscented Kalman Filter . . . . .</i>                           | 4        |
| 3.2      | <i>Estimation With Timestamp . . . . .</i>                         | 4        |
| 3.3      | <i>Estimation Without Timestamp . . . . .</i>                      | 4        |
| <b>4</b> | <b>Results . . . . .</b>   | <b>5</b> |
| 4.1      | <i>Unicycle Position Estimation . . . . .</i>                      | 5        |
| 4.1.1    | Measurement Signal-to-Noise Ratio Variation . . . . .              | 5        |
| 4.1.2    | Average Sampling Rate Variation . . . . .                          | 5        |
| 4.1.3    | Regular and Average Irregular Time Interval Relation Variation . . | 5        |
| <b>5</b> | <b>Conclusion . . . . .</b>  | <b>6</b> |
|          | <b>Bibliography . . . . .</b>                                      | <b>7</b> |

## 1 Introduction

### 1.1 *Motivations*

Nature has learned to merge multiple information from several sources a long time ago, in order to have a better perception of the environment. Animals combine signals received by different senses, such as sight, hearing, smell, taste and touch to recognize the surroundings. Plants have an analogous sensory system, used to water consumption modulation, leaf-colour changes or structure bending towards the light, for instance. Throughout history evolution has led to highly complex and efficient multi-sensor systems in living beings. Nowadays information fusion is studied in many fields of science, as a way of exploiting information from multiple sources to achieve better outcomes in comparison to those obtained if any of these sources were used separately (BOSTRÖM et al., 2007; ELMENREICH, ).

### 1.2 *Problem Formulation*

Apresentação matemática do problema, de forma ampla. Descrever as premissas adotadas.

### 1.3 *Objectives*

1 frase para o objetivo geral Objetivos específicos

### 1.4 *Thesis Structure*

## **2 Literature Review**

### *2.1 Multi-Sensor Systems*

### *2.2 Irregular Sampled Systems*

### *2.3 State Estimation Under Irregular Sampling*

#### 2.3.1 Known Measurement Instance

#### 2.3.2 Unknown Measurement Instance

### **3 Material and Methods**

#### *3.1 Unscented Kalman Filter*

#### *3.2 Estimation With Timestamp*

#### *3.3 Estimation Without Timestamp*

## 4 Results

### 4.1 *Unicycle Position Estimation*

#### 4.1.1 Measurement Signal-to-Noise Ratio Variation

#### 4.1.2 Average Sampling Rate Variation

#### 4.1.3 Regular and Average Irregular Time Interval Relation Variation

## 5 Conclusion

## Bibliography

BOSTRÖM, H. et al. *On the definition of information fusion as a field of research*. [S.l.], 2007. Citado na página 2.

ELMENREICH, W. Research Report, *An Introduction to Sensor Fusion*. Citado na página 2.