

Your Thesis Title in English

Le titre de votre thèse en français

Thèse de doctorat de l'université Paris-Saclay

École doctorale n° 580, Sciences et Technologies de l'Information et de la
Communication (STIC)

Spécialité de doctorat: Automatique

Graduate School : Sciences de l'Ingénierie et des Systèmes. Référent : Université
d'Évry Val d'Essonne

Thèse préparée dans l'unité de recherche **IBISC (Université Paris-Saclay, Univ Evry)**,
sous la direction de **Prénom NOM**, Titre, Établissement

Thèse soutenue à Paris-Saclay, le JJ mois AAAA, par

Prénom NOM

Composition du jury

Membres du jury avec voix délibérative

Prénom NOM

Titre, Établissement

Prénom NOM

Titre, Établissement

Prénom NOM

Titre, Établissement

Prénom NOM

Titre, Établissement

Président-e

Rapporteur-ric

Rapporteur-ric

Examineur-ric

Titre: Le titre de votre thèse en français

Mots clés: mot-clé 1, mot-clé 2, mot-clé 3, mot-clé 4

Résumé:

Saisissez ici le résumé de votre thèse en français. Présentez brièvement le contexte, la problématique, les contributions prin-

cipales et les résultats obtenus. Ce texte apparaît dans le cadre « Résumé » de la deuxième page de couverture, sous la forme à deux colonnes imposée par l'université.

Title: Your thesis title in English

Keywords: keyword 1, keyword 2, keyword 3, keyword 4

Abstract:

Write your English abstract here. Briefly state the context, the problem you address, your main contributions, and the key

results. This text appears in the "Abstract" box on the second cover page, in the two-column layout required by the university.

Dedicated to ...

Contents

List of Figures	ix
List of Tables	xi
Acronyms	xiii
Nomenclature	xv
1 General Introduction	1
1.1 Context and Motivation	1
1.2 Thesis Outline and Contributions	1
2 Template Showcase	3
2.1 Colored theorem boxes	3
2.2 Equations and symbols	4
2.3 Figures	4
2.4 Tables	4
2.5 Algorithms	4
3 Conclusion and Perspectives	7
3.1 Conclusion	7
3.2 Perspectives	7
A Appendix	9
A.1 Additional proofs	9
Bibliography	11

Acknowledgments

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

List of Figures

2.1	An example figure. Replace with your own graphic.	4
2.2	Two subfigures referenced as (a) and (b).	4

List of Tables

2.1 An example table.	4
-------------------------------	---

Acronyms

LMI linear matrix inequality. 3

MAS multi-agent system. 1

UAV unmanned aerial vehicle. 1

Nomenclature

Algebra and Operations

* Symmetric entry in a matrix

$\text{diag}(a_1, \dots, a_n)$ Diagonal matrix with diagonal entries a_1, \dots, a_n

$\text{He}(A)$ Sum of a square matrix and its transpose, $A + A^T$

$A \otimes B$ Kronecker product of matrices A and B

$A > 0$ (resp. $A \geq 0$) Positive definite (resp. semi-definite) matrix A

A^T Transpose of matrix A

I_n Identity matrix of dimension n

Multi-Agent Systems

\mathcal{G} Graph

\mathcal{L} Graph Laplacian matrix

\mathcal{N}_i Set of neighbors of agent i

\mathcal{V}, \mathcal{E} Set of nodes, set of edges

N Number of agents

Sets

\mathbb{N} (resp. \mathbb{N}_{++}) Set of natural numbers (resp. positive natural numbers)

\mathbb{R} Set of real numbers

\mathbb{R}^n Set of vectors of dimension n

$\mathbb{R}^{n \times m}$ Set of matrices of dimension $n \times m$

\mathbb{Z} Set of integers

1 -General Introduction

1.1 .Context and Motivation

Start with the big picture. Acronyms are handled by the glossary package: the first use of multi-agent system (MAS) prints the full form, and later uses such as MAS print only the short form. Plurals work too, e.g. unmanned aerial vehicles (UAVs). Cite references with `\cite{...}`, for instance [Olfati-Saber and Murray, 2004, Ren et al., 2008].

A quotation set with the `dirtytalk` package looks like this: “*a quote rendered with \say*”.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

1.2 .Thesis Outline and Contributions

Summarise each chapter and your contributions. Cross-reference chapters and sections with labels, e.g. see Chapter 2 and Section 2.2.

Chapter 2 demonstrates the theorem boxes, figures, tables, algorithms and equations available in this template.

1. First contribution ...
2. Second contribution ...
3. Third contribution ...

2 -Template Showcase

This chapter demonstrates every custom feature defined in `main.tex`: colored theorem boxes, plain theorem environments, equations, figures, tables, and algorithms. Use it as a cheat-sheet, then delete it.

2.1 .Colored theorem boxes

The template provides `tcolorbox`-based environments that take three arguments: an optional list of options, a title, and a label. They are breakable across pages and numbered within the section.

Definition 2.1.1 Consensus

A multi-agent system reaches *consensus* if all agents asymptotically agree on a common quantity of interest, i.e. $\|x_i(t) - x_j(t)\| \rightarrow 0$ as $t \rightarrow \infty$ for all agents i, j .

Assumption 2.1.1 Connected graph

The communication graph \mathcal{G} is undirected and connected.

Lemma 2.1.1 Schur complement

For a symmetric matrix, positive definiteness can be characterized through its Schur complement. Reference it later with `\ref`, e.g. Lemma 2.1.1.

Theorem 2.1.1 Main result

State your main theorem here. Boxes for `proposition`, `property`, `corollary` and `example` are also available.

Remark. For lightweight statements you can still use the plain (un-boxed) environments `theorem`, `definition`, `lemma`, `remark`, etc.

A boxed procedure using the `mydesignprocedure` style:

Design procedure

1. Solve the linear matrix inequality (LMI) feasibility problem.
2. Recover the controller gain.
3. Validate in simulation.

2.2 .Equations and symbols

The math macros give quick access to common notation, e.g. \mathbb{R}^n , $\text{diag}(a_1, \dots, a_n)$, $\text{He}(A) = A + A^T$, and \bar{A} . Consider the multi-agent dynamics

$$\dot{x}_i(t) = Ax_i(t) + Bu_i(t), \quad i \in \{1, \dots, N\}, \quad (2.1)$$

where $x_i \in \mathbb{R}^n$ and $u_i \in \mathbb{R}^m$. Refer back to equation (2.1) with `\eqref`.

2.3 .Figures

Use `\includegraphics` for external images. Every captioned figure appears automatically in the List of Figures.



Figure 2.1: An example figure. Replace with your own graphic.

Two side-by-side subfigures with the `subfig` package:



(a) First case.



(b) Second case.

Figure 2.2: Two subfigures referenced as (a) and (b).

2.4 .Tables

A clean table using `booktabs`. Captioned tables appear in the List of Tables.

Table 2.1: An example table.

Method	Communications	Error
Time-triggered	1000	0.012
Event-triggered	214	0.015
Proposed	142	0.013

2.5 .Algorithms

The `algorithm` and `algpseudocode` packages format pseudo-code:

Algorithm 1 Event-triggered update

```
1: Initialize  $x_i(0)$  for all agents  $i$ 
2: for each time step  $t$  do
3:   for each agent  $i$  do
4:     if triggering condition holds then
5:       Broadcast  $x_i(t)$  to neighbors  $\mathcal{N}_i$ 
6:       Update control input  $u_i(t)$ 
7:     end if
8:   end for
9: end for
```

3 -Conclusion and Perspectives

3.1 .Conclusion

Summarise the contributions of the thesis and the main findings.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

3.2 .Perspectives

Outline directions for future work.

- Perspective 1 ...
- Perspective 2 ...

A -Appendix

A.1 .Additional proofs

Place lengthy proofs or derivations here.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Bibliography

- [Olfati-Saber and Murray, 2004] Olfati-Saber, R. and Murray, R. (2004). Consensus problems in networks of agents with switching topology and time-delays. *IEEE Transactions on Automatic Control*, 49(9):1520–1533.
- [Ren et al., 2008] Ren, L.-H., Ding, Y.-S., Shen, Y.-Z., and Zhang, X.-F. (2008). Multi-agent-based bio-network for systems biology: protein–protein interaction network as an example. *Amino Acids*, 35(3):565–572.