Avis de Soutenance

THESE DE DOCTORAT

Présentée par

Monsieur AYOUB CHEDDOUR

Discipline : Mathématiques
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Sujet de la thèse

Stabilization of infinite-dimensional dynamical systems governed by semi linear differential equations with distributed delay

Formation Doctorale " Sciences de l'Ingénieur, Sciences Physique, Mathématiques et Informatique"

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Nom et Prénom	Titre	Etablissement	
Mohamed OUZAHRA	PES	Ecole Normale Supérieure de Fès	Président
Zakaria EL ALLALI	PES	Faculté Polydisciplinaire de Nador	Rapporteur
Abdelaziz TAAKILI	PES	Ecole Nationale Supérieure des Arts et Métiers de Meknès	Rapporteur
Youssef AKDIM	PES	Faculté des Sciences Dhar El Mehraz de Fès	Rapporteur
Soumia LALAOUI RHALI	PES	Faculté Polydisciplinaire de Taza	Examinateur
Abdelkarim BOUA	PH	Faculté Polydisciplinaire de Taza	Examinateur
Karim EL MOUTAOUAKIL	PH	Faculté Polydisciplinaire de Taza	Examinateur
Abdelhai EL AZZOUZI	PES	Faculté Polydisciplinaire de Taza	Directeur de Thèse

Laboratoire de recherche : Sciences de L'Ingénieur
Etablissement : Faculté Polydisciplinaire de Taza

Résumé de la thèse

This thesis explores the feedback stabilization of infinite-dimensional semi-linear systems with distributed delays. The focus is on developing control strategies and observability conditions to achieve various levels of stabilization, including weak, strong, and exponential stabilization.

In the first chapter, we present the main results needed through this thesis. It is mainly about some definitions, theorems and properties concerning the C0-semigroup theory, and it's application in delay differential equations. Moreover, we give some results and definitions about control and stabilization of semilinear system with delay.

In the second chapter, we consider the decomposition of the Hilbert phase space and we propose a bounded feedback control to study the weak, strong and exponential stabilization of bilinear systems with discrete delay in a Hilbert space. Firstly, we discuss the well possedness of mild solutions of the considered systems. Secondly, some sufficient conditions are given to guarantee the feedback stabilization for the bilinear systems. The stabilization results are given in term of observation estimates. Furthermore, an explicit decay estimate of the stabilized state is obtained in the strong stabilization case.

In the third chapter, a sequence of feedback control is introduced to prove the exponentially and weakly stabilization of the semi-linear systems with discrete multi-delays. Additionally, a simple observability condition is presented, which is easy to verify in practical applications.

The fourth chapter concentrates on the feedback stabilization analysis of the semilinear system with distributed delay. General results are provided, utilizing an observability condition based on the semigroup solution of the lineair part of the considered system. Results on the weak, strong, and exponential stabilization of the system are obtained using quadratic and normalized controls. The feedback stabilization of bilinear systems is also discussed, employing the decomposition method of the state space.

In the fifth chapter, a novel family of feedback controls is proposed to stabilize a class of infinite-dimensional semilinear systems with distributed delay. This family of controls enables strong and weak stabilization of the closed-loop semilinear system. Furthermore, it is shown that one specific control within this family can be characterized as the unique solution of an appropriate minimization problem, making it applicable to physical and biological systems.

The final chapter focuses on the strong and weak stabilization of a class of bilinear systems with distributed delay in the Banach space using feedback control. By imposing an observability condition expressed in terms of the semigroup solution of the lineair part of the system considered, strong stabilization of the system is demonstrated, along with explicit decay estimate. Moreover, the weak

stabilization is also proven using the conditions other than the observability condition used in strong stabilization.

We mention that at the end of each chapter, some examples of application are provided. Moreover, numerical simulations are given to show the applicability of our theoretical results.