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#### REPORT ON THE HABILITATION THESIS BY CHRISTOPHE PRIEUR

To whom it may concern:

This report concerns the Habilitation Thesis by Christophe Prieur, "Contrôlabilité et stabilisation optimales en dimension finie et infinie".

In this Thesis the author collects his most relevant and recent research work on the control and stabilization of finite and infinite-dimensional dynamical systems. This is one of the very first qualities of the Thesis and of the work carried out by the author: The fact that he has been working both in the finite and in the infinite-dimensional context, which are too often developed by disjoint mathematical communities. The candidate is one of those rare researchers able to do relevant contributions in both fields.

The Habilitation Thesis, after a general introduction, is divided in two parts, each of them being constituted by three different chapters. The first one is devoted to finite-dimensional systems while the second one to Partial Differential Equations. They contain a description of the main research contributions done by the authors since he got his PhD degree in 2001.

Let me describe the content of each of these two parts.

As mentioned above, the first part is devoted to finite-dimensional systems. In the first chapter the author describes the problem of stabilization, and the well known Brockett's condition which forces the use of discontinuous

controls, a topic that the author has worked on in an intensive manner. In a recent article in collaboration with R. Gaubel and A. Tedi he analyzes a hybrid control strategy for which they give sufficient conditions for stabilization, which are robust under noise and perturbations. This last aspect is particularly relevant in the work of the candidate. Indeed, there exists a huge literature on the stabilization of ODE's and PDE's but applications require more and more the robustness of the feedback mechanisms employed. Thus, the results in this respect are particularly relevant. In a second paper, the same authors establish the link of these stabilization results with the existence of Control Lyapunov Functions. This is also a deep and important result since Lyapunov functionals constitute a physical and handable way of testing and mastering stability.

In the second chapter of the first part the author presents the results of a joint work with E. Trélat in which they develop the optimal control synthesis of hybrid discrete-continuous systems, answering to a question previously formulated by A. Bressan.

The third chapter is devoted to the important problem of systems with saturations. The author provides sharp results on the stability region of these systems in terms of linear matrix inequalities. An analysis of the numerical complexity is also developed.

The first chapter of the second part is devoted to the control of a one-dimensional flexible beam under the action of a piezo-electric controller. In a joint work with E. Crépeau the author proves the controllability under suitable assumptions on the location of the controller. These assumptions are of number theoretical nature. Numerical experiments are also developed describing the accuracy of those results. Extensions to the problem of stabilization are also given.

The second chapter is devoted to the control of two-dimensional plates in the context of correction of wave fronts in telescopes by means of adaptive optics. This is done, once more, through piezoelectric actuators. The author proposes first a model that he has developed in collaboration with M. Lenczner in one space dimension through homogenization that they extend to the two-dimensional setting. The chapter also contains results on the exponential stabilization by feedback, and on robust control.

The last chapter is devoted to the boundary control of hyperbolic systems and more precisely to the so-called Saint-Venant equations for shallow waters. This chapter contains very interesting stabilization results that not only have been validated numerically but also experimentally in the Sambre river in Belgium.

The Habilitation Thesis is complemented by a chapter in which the author discusses a number of open problems and directions for continuing research in these topics.

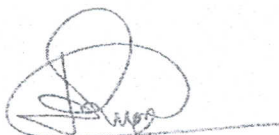
Overall this is an interesting collection of original research articles in which the candidate shows capacities to develop original research in the complex and important field of control and stabilization of dynamical systems, both in finite and infinite dimensions, integrating various techniques and cooperating with a wide range of scientists with different expertises.

Christophe Prieur is a mature researcher that deserves the Habilitation Diploma as a first step to the obtention of a promotion of a Professorship position in the french academic system.

I am at your disposal for any further information you might need.

Yours sincerely,

Bilbao, October 11th, 2009

A handwritten signature in black ink, appearing to be 'E. Zuazua', written over a horizontal line.

Enrique Zuazua, Ikerbasque Research Professor & Scientific Director, BCAM