

# Design of saturated boundary control of hyperbolic systems

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**Internship at Gipsa-lab,  
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**Keywords:** Nonlinear systems, infinite dimensional systems, boundary controllers, Lyapunov methods

**Starting date of the Internship:** February, 1st 2019

**End date of the Internship:** to be determined

**Description:** The general context of this internship is the boundary control of a class of infinite-dimensional systems, more precisely those described by hyperbolic partial differential equations. This class of systems is very relevant for many applications; see [1] for a recent textbook on this subject. Currently, different methodologies to design boundary controllers for this kind of distributed parameter systems exist, e.g., Lyapunov methods [1], backstepping transformation [4], or frequency domain approaches as in [5].

The focus of this internship is on the design of saturating boundary controllers. To achieve this objective, the candidate will make use of Lyapunov tools [1], combined with sector-bounded properties of the saturation nonlinearity; see [6]. As a first step, the candidate will focus on internal saturating controllers. Next, the attention will be turned to nonlinear boundary controllers; see [7]. Finally dynamical boundary controllers may be considered. The main difficulty in this latter cases pertains to the presence of unbounded control operators, which renders the problem significantly harder.

The final outcome of this project consists of addressing the problem of designing saturating controllers, with an opportunity to further design anti-windup architectures to improve closed-loop performance. Numerical simulations will be used to illustrate the obtained results and to gauge any kind of performance loss, induced by the presence of saturating actuators, as, e.g., the reduction of the convergence speed for the closed-loop system.

This internship may be followed by a PhD thesis, e.g., by considering related issues on nonlinear partial differential equations as the Kuramoto-Sivashinsky systems [2], or time-varying velocities and time-dependent boundary disturbances [3].

## References

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