

ICRAMCS 2026

THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON
RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 23-24-25, 2026 | Marrakech, Morocco



Exponential stabilization of Kuramoto Sivashinsky equation with input saturation

Communication Info

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Keywords:

- (1) Kuramoto Sivashinsky equation
- (2) exponential stability
- (3) input saturation
- (4) dissipativity
- (5) semilinear systems

Abstract

This research investigates the exponential stabilization of a Kuramoto Sivashinsky equation [1] with input saturation. The system is governed by a partial differential equation (PDE) with a nonlinear saturation function applied to the control input, ensuring bounded actuation. A spectral analysis of the associated linear operator is carried out to determine the admissible range of the parameter λ that guarantees stability. The control f is given by $f(s, t) = -\text{sat}(a(s)x(t, s))$ with sat is the saturation function [2] and $a(s)$ is a positive function that satisfies some specific conditions [3]. Using nonlinear semigroup theory [4], we first establish the well-posedness of the closed-loop system under a saturating feedback control law. The exponential stabilization result is then proved by a contradiction argument commonly employed for this class of equations. Numerical simulations are provided to validate the theoretical results, demonstrating the effectiveness of the proposed approach.

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