

ICRAMCS 2026

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

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



Necessary and sufficient conditions for strong stabilization of second-class bilinear time-delay

Communication Info

Authors:

Otmane Ghilli¹
Azzeddine Tsouli²

¹ ENS, Hassan II University of
Casablanca, Casablanca

² ENSAM, , Hassan II University
of Casablanca, Casablanca

Keywords:

- (1) Bilinear systems
- (2) Second order
- (3) Necessary and sufficient conditions
- (4) Strong stabilization
- (5) Time delay

Abstract

This paper addresses the strong stabilization problem for a class of second-order distributed bilinear systems subject to a constant time delay. The study is conducted within a Hilbert space framework, where the system is controlled by a continuous feedback law. We establish sufficient conditions ensuring strong stabilization using a simple feedback control that depends on the delayed state and velocity. Furthermore, a necessary condition for strong stabilization is derived, showing that the absence of certain persistent motions is required [1]. The method builds on the approach developed by Couchouron [2] for second-order bilinear systems without time delay, which uses diagonal observability inequalities [3,4]. Our approach relies on compactness arguments and the properties of the skew-adjoint operator generating the undamped dynamics. Illustrative examples are provided, drawing on the literature and opening new perspectives for the stabilization of time-delay systems with unbounded control operators.

© ICRAMCS 2026 Proceedings ISSN: 2605-7700

References

- [1] Abdallah, C., Dorato, P., Benites-Read, J., Byrne, R.: Delayed positive feedback can stabilize oscillatory systems, pp. 3106{3107 (1993).
- [2] Arino, O., Sanchez, E.: Linear theory of abstract functional differential equations of retarded type. Journal of Mathematical Analysis and Applications 191(3), 547{571 (1995)
- [3] Kunisch, K., Schappacher, W.: Necessary conditions for partial differential equations with delay to generate c_0 -semigroups. Journal of Differential Equations 50(1), 49{79 (1983)
- [4] Couchouron, J.-F.: Strong stabilization of controlled vibrating systems. ESAIM: Control, Optimisation and Calculus of Variations 17, 1144{1157 (2011).
- [5] Ammari, K., Nicaise, S.: Stabilization of second order evolution equations with unbounded feedback with delay. Lecture Notes in Mathematics -Springer-verlag-2124, 61{71 (2015)