

Systems and Control Group Seminar

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Room 11.1.12

Mathematics Department, University of Aveiro

A Hybrid Framework for Reaction–Diffusion Epidemic Dynamics and Oscillatory behaviors

Asmae Tajani

ENS, University Hassan II, Casablanca, Morocco

CIDMA, University of Aveiro, Portugal

tajaniasmae@ua.pt

Abstract

In this work, we construct a hybrid epidemic mathematical model based on a reaction–diffusion system of the SIR (susceptible–infected–recovered) type. This model integrates the impact of random factors on the transmission rate of infectious diseases, represented by a probabilistic process acting at discrete time steps. The hybrid model couples a continuous reaction–diffusion system, which describes the spatiotemporal dynamics of the infectious disease, with a discrete probabilistic process that models potential change in the transmission rate. We establish properties of both biological and mathematical interest in the hybrid model, including the existence of global solutions, stability analysis of equilibrium points, and the emergence of oscillatory behaviors. Additionally, we extend the hybrid model by including vaccination. The dynamics and emergence of oscillations in the hybrid model are investigated under various scenarios, which are illustrated through numerical simulations.

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