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Title: The lack of exponential stability for a weakly coupled wave equations through a variable density term

Abstract: In this work, we focus on studying systems that consist of two oscillators that are coupled together in some way and that have more than one frequency of oscillation. This coupling produces new and important physical effects, and the study of their stabilization is much more involved. Mathematically, in our structural systems, we are concerned with resistance coupling that brings energy loss and a rapid decay in the vibration.

In this area, we consider a system of two wave equations coupled through zero-order terms. One of these equations has an internal damping, and the other has a boundary damping. We investigate stability properties of the system according to the variable string densities. Indeed, our main result is to show that the corresponding model is not exponentially stable using spectral theory, which forms the core of this work. Otherwise, we establish a polynomial energy decay rate of type $\frac{1}{\sqrt{t}}$.