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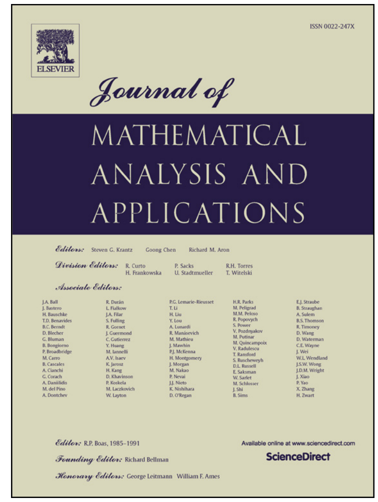

General decay of solutions in one-dimensional porous-elastic system with memory

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General decay of solutions in one-dimensional porous-elastic system with memory

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Abstract. In this work we consider a one-dimensional porous-elastic system with memory effects. It is well-known that porous-elastic system with a single dissipation mechanism lacks exponential decay. In contrary, we prove that the unique dissipation given by the memory term is strong enough to exponentially stabilize the system, depending on the kernel of the memory term and the wave speeds of the system. In fact, we prove a general decay result, for which exponential and polynomial decay results are special cases. Our result is new and improves previous results in the literature.
Keywords: Porous system; General decay; Exponential Decay, Memory term; Relaxation function.
AMS Subject Classifications: 35B35; 35B40; 93D20

1. Introduction

In the present work, we are concerned with the following problem

$$\begin{aligned} &\rho u_{tt} - \mu u_{xx} - b\phi_x = 0, \qquad \text{in } (0,1)\times(0,\infty) \\ &J\phi_{tt} - \delta\phi_{xx} + bu_x + \xi\phi + \int_0^t g(t-s)\phi_{xx}(x,s)ds = 0, \ \text{in } (0,1)\times(0,\infty) \end{aligned} \tag{1.1}$$

a porous-elastic system with memory term acting only on the porous equation together with the initial data

$$u(x,0) = u_0(x), \ u_t(x,0) = u_1(x), \ \phi(x,0) = \phi_0(x), \ \phi_t(x,0) = \phi_1(x), \ x \in [0,1] \tag{1.2}$$

and Neumann-Dirichlet boundary conditions

$$u_x(0,t) = u_x(1,t) = \phi(0,t) = \phi(1,t) = 0 \qquad t \geq 0. \tag{1.3}$$

Here, u is the longitudinal displacement, ϕ is the volume fraction of the solid elastic material, and $\rho, \mu, b, J, \delta, \xi$ are constitutive constants which are positive with μ, ξ, b satisfying $\mu\xi > b^2$. The integral represents the memory term and g is the relaxation function satisfying the following:

(H1) $g : \mathbb{R}_+ \to \mathbb{R}_+$ is a C^1 decreasing function satisfying

$$g(0) > 0, \qquad \delta - \int_0^\infty g(s)ds = l > 0.$$