

EXPONENTIAL DECAY FOR MICROTEMPERATURES DAMPED POROUS ELASTIC SYSTEM

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Abstract. In this paper, we consider a one-dimensional porous-elastic system with dissipation due to only microtemperatures. It is worth mentioning that such a system with additional damping terms lacks exponential stability unless another damping mechanism is added. In this work, however, we prove that the unique dissipation due to the microtemperatures is strong enough to exponentially stabilize the system, but regardless of the wave speeds of the system χ which mentioned in [4, 31] or any other condition on the coefficients. Our result is new and improves previous results in the literature.

Keywords. Micro-temperatures, Porous elasticity, semigroup theory, exponential decay.

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1 Introduction

It is known that elastic solids with voids is one of the celebrated extensions of the theory of the classical elasticity, it contributes to the study of porous solids in which the matrix material is elastic and the interstices are void of material (see Goodman and Cowin [18] and Nunziato and Cowin [26] for details). In the last decades, porous elastic systems has been studied with different types of damping mechanisms. We refer the interested readers to [1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 20, 21, 23, 24, 25, 27, 30, 32] and the references therein for more details discussion on the subject.

The evolution equations for one-dimensional theories of porous materials with temperature and microtemperature is given by

$$\begin{cases} \rho u_{tt} = T_x, & J\phi_{tt} = H_x + G, \\ \rho\eta_t = q_x, & \rho E_t = P_x + q - Q. \end{cases}$$

Here T is the stress, H is the equilibrated stress, G is the equilibrated body force, q is the heat flux, η is the entropy, P is the first heat flux moment,