Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **10 (2003)** 127-137

DYNAMICAL ANALYSIS ON INCOMPRESSIBLE PRE-STRESSED NON-LOCAL ELASTIC MATERIAL

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Abstract. The basic equations for constrained materials are derived from general constitutive theory of nonlocal and nonlinear elasticity in dynamics. The equations are applied to incompressible, pre-stressed solid materials. With nonlocal consideration, the elastic moduli are no longer constants but are the functions of wave numbers and properties of microstructures which connect with spacing of atoms. The theoretical frame is established and the nonlocal elasticity is expanded to the constrained materials.
Keywords. Nonlinear dynamics, nonlocal elasticity, microstructures, constitutive relations, wave propagation, constrained materials.
AMS (MOS) subject classification: 74B20, 35M20, 34D05.

1 Introduction

The concept of nonlocal elasticity was developed in 60s and 70s [4, 9, 10]. The basic idea of nonlocal elasticity is that microstructures of materials are considered in constitutive equations. The theory of continuum mechanics such as basic balance laws and the second law of thermodynamics should be followed in the nonlocal theory. Classical continuum mechanics and nonlocal elasticity are not exactly same in theory. Some new concepts are proposed in nonlocal theory.

The nonlocal elasticity has been used to solve many micromechanics problems. Recently, the nonlocal theory has been applied to interface dislocations [15], inclusion theory [13], fracture mechanics [12], and the presentation of the boundary condition [14]. Gao [6, 7] considered an asymmetric theory of nonlocal elasticity. The concept of "nonlocal" has also been used in localization of void-sheet [19]. The propagation of Rayleigh surface waves was investigated in [3] for the nonlocal case. Nowinski [11] studied the propagation of love waves in a two dimensional half infinite medium and analyzed the nonlocal shear stress.

Dynamics theory has been widely applied in many research areas. Recently, Yu *et al.* [20–23] have considered dynamical motion of cable structures. A three degree of freedom oscillator model was developed for studying bifurcations and stability of iced conductor lines [20, 21]. Later, both static