Computational Asymptotic Method for Strain Gradient Elasticity

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In this paper, a computational asymptotic method is proposed for strain gradient elasticity problems. The strain gradient elasticity is useful for the elastic problems of structures made of porous materials, polar materials etc. in which a strain gradient effect is significant. Although a basic theory for the strain gradient elasticity is well established in literature, a systematic approach is relatively rare because of its complexity. In this paper, an attempt is made to asymptotically formulate the problem by employing a standard finite element discretization, so that one can clearly have physical insight of strain gradient effect. The method starts with the three-dimensional problem which will split into the two-dimensional microscopic and one-dimensional macroscopic problems for slender structures. The warping functions obtained are discussed in detail and compared to those of a conventional elasticity.

Keywords: Asymptotic method, Computational method, Strain gradient elasticity