
Discrete One-dimensional Models for the Electromomentum Coupling

Kevin Muhafr¹, Michael Haberman², and Gal Shmuel^{*†1}

¹Technion - Israel Institute of Technology – Israel

²The University of Texas at Austin – United States

Abstract

Willis dynamic homogenization theory revealed that the effective linear momentum of elastic composites is coupled to their effective strain. Recent generalization of Willis' dynamic homogenization theory to the case of piezoelectric composites further revealed that their effective linear momentum is also coupled to the effective electric field. Here, we introduce the simplest possible model - a one-dimensional discrete model that exhibits this so-called electromomentum coupling in subwavelength composites. We utilize our model to elucidate the physical origins of this phenomenon, illustrate its mechanism, and identify local resonances which lead to elevated Willis- and electromomentum coupling in narrow frequency bands. The results provide intuitive guidelines for the design of this coupling in piezoelectric metamaterials.

*Speaker

†Corresponding author: meshmuel@technion.ac.il