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Material symmetries of micropolar continua equivalent to lattices

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Abstract

Some aspects concerning the identification of continuum coarse models from fine discrete models are discussed. The preservation of the mechanical power, in the transition from the microscopic to the macroscopic description, is required. A procedure based on the equivalence of the virtual power provides a natural way to select the continuum satisfying this requirement. Having the advantages of an integral procedure, it gives good results if the coarse model is a multifield continuum with strain fields compatible with those of the fine model. In this situation both models share the same material symmetry group. This is shown with reference to rigid particle systems. In particular, the symmetry group of the discrete material is defined and its transformation into that of an equivalent micropolar continuum is studied in detail. Numerical analyses are also performed to investigate the effect of change in the material symmetries.

1. Introduction

According to the terminology adopted by Muncaster (1983), we call 'fine' description a model which provides detailed information about the actual behaviour of a medium. When not all the information provided is essential, it could be convenient to adopt a 'coarse' description retaining only the information sufficient to a global description of the behavior of the material. Techniques focused on the derivation of continuum coarse descriptions from different kinds of fine models have been receiving much attention and have been affording profitable results. Not only in mechanics of solids with microheterogeneities (Weng et al., 1990; Nemat-Nasser and Hori, 1993) but also, although from different points of view, in mechanics of structures when one or two-dimensional models are derived from the more detailed three-dimensional Cauchy model (e.g.

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