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The relaxed micromorphic model for the description of band- gaps in mechanical metamaterials

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Generalized continuum models are nowadays recognized to be a useful tool for the macroscopic description of the mechanical behavior of materials with heterogeneous microstructures showing exotic properties and/or size effects. In particular, a recently introduced generalized continuum model, which we called relaxed micromorphic has been shown to be well-adapted to describe very exotic behaviors of micro-structured materials in the dynamic regime [1], [2]. In particular, a relaxed micromorphic model is, to our knowledge, the only generalized continuum model which is able to describe complete band gaps with respect to elastic wave propagation. We study dispersion relations for the considered relaxed medium and we are able to disclose precise frequency ranges for which propagation of waves is inhibited (frequency band-gaps). We explicitly show that complete band-gaps phenomena cannot be accounted for by clas- sical micromorphic models of the Mindlin-Eringen type as well as by Cosserat and second gradient ones. We finally point out that such relaxed micromorphic model also gives rise to some very intriguing mathematical questions regarding its well-posedness.

References

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