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About computing the nonlinear interaction between weakly converging sequences and its influence in optimal design and nonlinear elasticity

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Abstract

When solving a calculus of variations problem, very often one encounters weakly converging sequences that interact in a nonlinear manner. Two paradigmatic examples of this are the broad area of optimal design, see [1], and the characterization of the energy density functions to be used in nonlinear elasticity. For the latter we present the use of Compensated Compactness, [6], to derive a computational method to look for the elusive counterexample of a rank-one, non quasiconvex energy density in the planar case, see [4] and [5]. In the context of optimal design we present the small amplitude homogenization approach introduced in [2] and used later in [3], which is based on the use of the technique of H-measures introduced by L. Tartar in [7], to compute the interaction between the design variable and the state function.

References

[1] G. Allaire, *Shape Optimization by the Homogenization Method*. Springer-Verlag (2002).

[2] G. Allaire, S. Gutiérrez, *Optimal design in small amplitude homogenization*. ESAIM Math. Modelling and Numerical Analysis, 41(3) 543-574 (2007). Preprint available at http://www.cmap.polytechnique.fr/preprint/repository/576.pdf.

[3] S. Gutiérrez, J. Mura, *Small amplitude homogenization applied to inverse problems*. Computational Mechanics, 41(5) 699-706 (2008).

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[4] S. Gutiérrez, J. Villavicencio, *An optimization algorithm applied to the Morrey conjecture in nonlinear elasticity.* Int. J. of Solids and Structures, 44(10) 3177-3186 (2007).

[5] S. Gutiérrez, *A Necessary Condition for the Quasiconvexity of Polynomials of Degree Four*. J. of Convex Analysis 13(1) 51-60 (2006).

[6] L. Tartar, *Compensated Compactness and Applications to Partial Differential Equations*. Nonlineal Analysis and Mechanics; Heriot-Watt Symposium Vol. IV (Knops R.J. ed.) Research Notes in Mathematics, No. 39, Pitman (1979).

[7] L. Tartar, *H-measures, a new approach for studying homogenization, oscillations and concentration effects in partial differential equations*, Proc. of the Royal Soc. Edinburgh, 115A 193-230 (1990).