

AN INTRODUCTION TO THE CHEEGER PROBLEM

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Abstract. Given a bounded domain $\Omega \subset \mathbb{R}^n$ with Lipschitz boundary, the Cheeger problem consists of finding a subset E of Ω such that its ratio perimeter/volume is minimal among all subsets of Ω . This article is a collection of some known results about the Cheeger problem which are spread in many classical and new papers.

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References

- [1] F. Alter, V. Caselles, *Uniqueness of the Cheeger set of a convex body*, Nonlinear Analysis **70** (2009), 32-44. [MR2468216](#) (2009m:52005). [Zbl 1167.52005](#).
- [2] L. Ambrosio, N. Fusco, D. Pallara, *Functions of bounded variations and free discontinuity problems*, Oxford University Press, 2000.
- [3] B. Appleton, H. Talbot, *Globally minimal surfaces by continuous maximal flows*, IEEE Transactions on Pattern Analysis and Machine Intelligence **28** (2006), 106-118.
- [4] E. Bombieri, E. De Giorgi, E. Giusti, *Minimal cones and the Bernstein problem*, Inventiones mathematicae **7** (1969), 243-268. [MR0250205](#) (40#3445). [Zbl 0219.53006](#).
- [5] G. Buttazzo, G. Carlier, M. Comte, *On the selection of maximal Cheeger sets*, Differential Integral Equations **20** (2007), 991-1004. [MR2349376](#) (2008i:49025).
- [6] G. Carlier, M. Comte, *On a weighted total variation minimization problem*, Journal of Functional Analysis **250** (2007), 214-226. [MR2345913](#) (2008m:49006). [Zbl 1120.49011](#).

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- [7] V. Caselles, A. Chambolle, M. Novaga, *Some remarks on uniqueness and regularity of Cheeger sets*, Rendiconti del Seminario Matematico della Università di Padova **123** (2010), 191-201.
- [8] V. Caselles, G. Facciolo, E. Meinhardt, *Anisotropic Cheeger Sets and Applications*, SIAM Journal on Imaging Sciences **2** (2009), 1211-1254. [MR2559165](#). [Zbl 1193.49051](#).
- [9] J. Cheeger, *A lower bound for the smallest eigenvalue of the Laplacian*, Problems in analysis: A symposium in honor of Salomon Bochner (1970), 195-199. [MR0402831](#) (53#6645). [Zbl 0212.44903](#).
- [10] E. De Giorgi, *Sulla proprietà isoperimetrica dell'ipersfera, nella classe degli insiemi aventi frontiera orientata di misura finita*, Atti della Accademia Nazionale dei Lincei. Mem. Cl. Sci. Fis. Mat. Nat. Sez. I **5** (1958), 33-44. [MR0098331](#) (20#4792). [Zbl 0116.07901](#).
- [11] A. Figalli, F. Maggi, A. Pratelli, *A note on Cheeger sets*, Proceedings of the American Mathematical Society **137** (2009), 2057-2062. [MR2480287](#) (2009k:49081). [Zbl 1168.39008](#).
- [12] V. Fridman, *Das Eigenwertproblem zum p -Laplace Operator für p gegen 1*, Dissertation, Universität zu Köln, 2003.
- [13] C. Giacomelli, I. Tamanini, *Approximation of Caccioppoli sets, with applications to problems in image segmentation*, Annali dell'Università di Ferrara **35** (1989), 187-213. [MR1079588](#) (91j:49065). [Zbl 0732.49029](#).
- [14] E. Giusti, *Minimal surfaces and functions of bounded variation*, Birkhäuser, 1984.
- [15] E. Gonzalez, U. Massari, I. Tamanini, *Minimal boundaries enclosing a given volume*, Manuscripta mathematica **34** (1981), 381-395. [MR0620458](#) (83d:49081). [Zbl 0481.49035](#).
- [16] E. Gonzalez, U. Massari, I. Tamanini, *On the regularity of boundaries of sets minimizing perimeter with a volume constraint*, Indiana University Mathematics Journal **32** (1983), 25-37. [MR0684753](#) (84d:49043). [Zbl 0486.49024](#).
- [17] I.R. Ionescu, T. Lachand-Robert, *Generalized Cheeger sets related to landslides*, Calculus of Variations and Partial Differential Equations **23** (2005), 227-249. [MR2138084](#) (2006b:49091). [Zbl 1062.49036](#).
- [18] B. Kawohl, V. Fridman, *Isoperimetric estimates for the first eigenvalue of the p -Laplace operator and the Cheeger constant*, Commentationes Mathematicae Universitatis Carolinae **44** (2003), 659-667. [MR2062882](#) (2005g:35053). [Zbl 1105.35029](#).

- [19] B. Kawohl, T. Lachand-Robert, *Characterization of Cheeger sets for convex subsets of the plane*, Pacific Journal of Mathematics **225** (2006), 103-118. [MR2233727](#) (2007e:52002). [Zbl 1133.52002](#).
- [20] J.B. Keller, *Plate failure under pressure*, SIAM Review **22** (1980), 227-228. [Zbl 0439.73048](#).
- [21] L. Lefton, D. Wei, *Numerical approximation of the first eigenpair of the p -Laplacian using finite elements and the penalty method*, Numerical Functional Analysis and Optimization **18** (1997), 389-399. [MR1448898](#) (98c:65178). [Zbl 0884.65103](#).
- [22] U. Massari, *Esistenza e regolarità delle ipersuperfici di curvatura media assegnata in \mathbb{R}^n* , Archive for Rational Mechanics and Analysis **55** (1974), 357-382. [MR0355766](#) (50#8240). [Zbl 0305.49047](#).
- [23] U. Massari, L. Pepe, *Sull'approssimazione degli aperti lipschitziani di \mathbb{R}^n con varietà differenziabili*, Bollettino U.M.I. **10** (1974), 532-544. [MR0365318](#) (51#1571). [Zbl 0316.49031](#).
- [24] E. Parini, *Cheeger sets in the non-convex case*, Tesi di Laurea Magistrale, Università degli Studi di Milano, 2006.
- [25] G. Strang, *Maximal flow through a domain*, Mathematical Programming **26** (1983), 123-143. [MR0700642](#) (85e:90023). [Zbl 0513.90026](#).
- [26] E. Stredulinsky, W.P. Ziemer, *Area minimizing sets subject to a volume constraint in a convex set*, Journal of Geometrical Analysis **7** (1997), 653-677. [MR1669207](#) (99k:49089). [Zbl 0940.49025](#).
- [27] I. Tamanini, *Boundaries of Caccioppoli sets with Hölder-continuous normal vector*, Journal für die reine und angewandte Mathematik **334** (1982), 27-39. [MR0667448](#) (83m:49067). [Zbl 0479.49028](#).

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