Dedicated to Prof. Qamrul Hasan Ansari on the occasion of his 60<sup>th</sup> anniversary

## Limiting proper minimal points of nonconvex sets in finite-dimensional spaces

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## Abstract.

In this paper, limiting proper minimal points of nonconvex sets in Euclidean finite-dimensional spaces are investigated. The relationships between these minimal points and Borwein, Benson, and Henig proper minimal points, under appropriate assumptions, are established. Furthermore, a density property is derived and a linear characterization of limiting proper minimal points is provided.

## REFERENCES

- [1] Ansari, Q. H., Yao, J. C., Recent Developments in Vector Optimization, Springer, NY, 2012
- [2] Benson, H. P., An improved definition of proper efficiency for vector maximization with respect to cones, J. Math. Anal. Appl., 71 (1979), 232–241
- [3] Borwein, J. M., Proper efficient points for maximization with respect to cones, SIAM J. Optimiz., 15 (1977), 57-63
- [4] Clarke, F. H., Functional Analysis, Calculus of Variations and Optimal Control, Springer, London, 2013
- [5] Curşeu, A., A characterization of the efficient solutions of multiobjective optimization problems by means of a scalar problem, Bul. Ştiinţ. Univ. Baia Mare, Ser. B 15, (1999), No. 1-2, 79–87
- [6] Geoffrion, A., Proper efficiency and the theory of vector maximization, J. Math. Anal. Appl., 22 (1968), 618-630
- [7] Henig, M., Proper efficiency with respect to cones, J. Optimiz. Theory App., 36 (1982), 387-407
- [8] Jahn, J., Vector Optimization, Springer, Berlin, 2012
- Köbis, E. and Tammer, Chr., Robust vector optimization with a variable domination structure, Carpathian J. Math., 33 (2017), 343–351
- [10] Kuhn, H. and Tucker, A., Nonlinear programing, In J. Neyman (ed.), Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability. University of California Press, Berkeley, California, (1951) 481–492
- [11] Mordukhovich, B. S., Variational Analysis and Generalized Differentiation, I: Basic Theory, Springer-Verlag, Berlin, 2006
- [12] Sawaragi, Y., Nakayama, H. and Tanino, T., Theory of Multiobjective Optimization, Academic Press, Orlando, FL, 1985
- [13] Sayadi-bander, A., Basirzadeh, H. and Pourkarimi, L., Coradiant-valued maps and approximate solutions in variable ordering structures, Bull. Iran Math. Soc., 44 (2018), 1125–1139
- [14] Shahbeyk, S. and Soleimani-damaneh, M., Proper minimal points of nonconvex sets in Banach spaces in terms of the limiting normal cone, Optimization, 66 (2017), 473–489
- [15] Shahbeyk, S. and Soleimani-damaneh, M., Hartley properly and super nondominated solutions in vector optimization with a variable ordering structure, J. Global Optim., 71 (2018), 383–405

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