

HARDY INEQUALITIES WITH REMAINDER TERMS FOR THE GENERALIZED BAOUENDI–GRUSHIN VECTOR FIELDS

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Abstract. Based on the properties of vector fields and the generalized divergence formula, we prove the Hardy inequalities with remainder terms for the generalized Baouendi-Grushin vector fields and determine the best constants in these Hardy inequalities.

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REFERENCES

- [1] G. BARBATIS, S. FILIPPAS AND A. TERTIKAS, *A unified approach to improved L^p Hardy inequalities with best constants*, Trans. Amer. Math. Soc., **356** (2004), 2169–2196.
- [2] G. BARBATIS, S. FILIPPAS AND A. TERTIKAS, *Series expansion for L^p Hardy inequalities*, Indiana Univ. Math. J., **52** (2003), 171–190.
- [3] W. BECKNER, *On the Grushin operator and hyperbolic symmetry*, Proc. Amer. Math. Soc., **129** (2001), 1233–1246.
- [4] L. D’AMBROSIO, *Hardy inequalities related to Grushin type operators*, Proc. Amer. Math. Soc., **132**, 3 (2004), 725–734.
- [5] L. D’AMBROSIO, *Hardy type inequalities related to second order degenerate differential operators*, Ann. Scuola Norm. Sup. Pisa Cl. Sci., ser. **5**, IV (2005), 451–486.
- [6] J. DOU, P. NIU, AND Z. YUAN, *A Hardy Inequality with Remainder Terms in the Heisenberg Group and the Weighted Eigenvalue Problem*, J. Inequ. Appl. 2007(2007), Article ID 32585, 24 pages.
- [7] B. FRANCHI AND E. LANCONELLI, *Une metrique associée à une classe d’opérateurs elliptiques dégénérés*, Proceedings of the meeting Linear partial and pseudodifferential operators, Rend. Sem. Mat. Univ. e Politec. Torino, (1983), 105–114.
- [8] B. FRANCHI AND E. LANCONELLI, *Hölder regularity theorem for a class of linear nonuniformly elliptic operators with measurable coefficients*, Annali Scuola Normale Sup. Pisa, Cl. Sci. (A) IV. Ser. **10** (1983), 523–541.
- [9] B. FRANCHI AND E. LANCONELLI, *An embedding theorem for Sobolev spaces related to non-smooth vector fields and Harnack inequality*, Comm. P. D. E., **9** (1984), 1237–1264.
- [10] J. GARCÍA AZORERO, AND I. PERAL, *Hardy inequality and some critical elliptic and parabolic problems*, J. Diff. Eqs., **144** (1998), 441–476.
- [11] N. GAROFALO AND D.M. NHIEU, *Isoperimetric and Sobolev inequalities for Carnot-Carathéodory spaces and the existence of minima surfaces*, Comm. Pure Appl. Math., **49** (1996), 1081–1144.
- [12] N. GAROFALO, *Unique continuation for a class of elliptic operators which degenerate on a manifold of arbitrary codimension*, J. Diff. Eqs., **104** (1993), 117–146.
- [13] A. LOIUDICE, *Sobolev inequalities with remainder terms for sublaplacians and other subelliptic operators*, NoDEA Nonlinear Differ. Eqs. Appl., **13** (2006), 119–136.
- [14] P. NIU, J. DOU AND H. ZHANG, *Nonexistence of weak solutions for the p -degenerate subelliptic inequalities constructed by the Generalized Baouendi-Grushin vector fields*, Georgian Math. J., **12**, 4 (2005), 727–742.
- [15] H. ZHANG AND P. NIU, *Picone identity and Hardy inequality for a class of vector fields*, J. Math., **23** (2003), 121–125 (in Chinese).