

DOI: 10.21538/0134-4889-2016-22-4-64-80

MSC: 58J40, 35S05, 42B05

**The  $L_p$ -BOUNDEDNESS OF SOME CLASSES OF PSEUDO-DIFFERENTIAL OPERATORS ON THE  $m$ -DIMENSIONAL TORUS<sup>1</sup>**

**D. B. Bazarkhanov**

We prove that certain classes of pseudo-differential operators with symbols that are nonsmooth in the spatial variable are  $L_p$ -bounded on the  $m$ -dimensional torus for  $1 \leq p \leq \infty$ .

Keywords: pseudo-differential operator, symbol, bounded operator,  $m$ -dimensional torus.

**REFERENCES**

1. Hörmander L. *The analysis of linear partial differential operators III: Pseudodifferential operators*. Berlin, Heidelberg: Springer-Verlag, 1985, Ser. Fundamental Principles Math. Sci, vol. 274. 525 p.
2. Kumano-go H. *Pseudo-differential operators*. Cambridge: MIT Press, 1982, 455 p.
3. Stein E.M. *Harmonic analysis: real-variable methods, orthogonality, and oscillatory integrals*. Princeton: Princeton Univ. Press, 1993, 716 p.
4. Hörmander L. Pseudo-differential operators and hypoelliptic equations. *Singular Integrals, Chicago, IL, 1966*, Providence: Amer. Math. Soc., 1967, Ser. Proc. Sympos. Pure Math. 10, pp. 138–183.
5. Hörmander L. On the  $L^2$  continuity of pseudo-differential operators. *Comm. Pure Appl. Math.*, 1971, vol. 24, pp. 529–535.
6. Calderon A. P., Vaillancourt R. A class of bounded pseudo-differential operators. *Proc. Nat. Acad. Sci. U.S.A.*, 1972, vol. 6, pp. 1185–1187.
7. Coifman R. R., Meyer Y. Au-dela des operateurs pseudo-differentiels. *Asterisque*, 1978, vol. 57, pp. 1–185.
8. Hounie J. On The  $L^2$  continuity of pseudo-differential operators. *Communications in Partial Diff. Eq.*, 1986, vol. 11, no. 7, pp. 765–778.
9. Ching C.H. Pseudo-differential operators with nonregular symbols. *J. Diff. Eq.*, 1972, vol. 11, pp. 436–447.
10. Rodino L. On the boundedness of pseudo differential operators in the class  $L_{\varrho,1}^m$ . *Proc. Amer. Math. Soc.*, 1976, vol. 58, no. 1, pp. 211–215.
11. Fefferman C.  $L^p$  bounds for pseudo-differential operators. *Israel J. Math.*, 1973, vol. 14, pp. 413–417.
12. Nagase M. The  $L^p$ -boundedness of pseudo-differential operators with non-regular symbols. *Communications in Part. Diff. Eq.*, 1977, vol. 2, no. 10, pp. 1045–1061.
13. Kenig C. E., Staubach W.  $\Psi$ -pseudodifferential operators and estimates for maximal oscillatory integrals. *Studia mathematica*, 2007, vol. 183, no. 3, pp. 249–258.
14. Ruzhansky M., Turunen V. *Pseudo-differential operators and symmetries: background analysis and advanced topics*. Basel, Birkhauser: Springer, 2009, 710 p.
15. Ruzhansky M., Turunen V. Quantization of pseudo-differential operators on the torus. *J. Fourier Anal. Appl.* 2010, vol. 16, no. 6, pp. 943–982.
16. Delgado J.  $L_p$ -bounds for pseudo-differential operators on the torus. *Operator Theory: Advances and Applications*, 2013, vol. 231, pp. 103–116.

<sup>1</sup>Received November 7, 2016

17. Cardona D. Weak type  $(1, 1)$  bounds for a class of periodic pseudo-differential operators. *J. Pseudo-Diff. Oper. Appl.*, 2014, vol. 5, no. 4, pp. 507–515.
18. Stein E., Weiss G. *Introduction to Fourier analysis on Euclidean spaces*, Princeton: Princeton University Press, 1971, Princeton Mathematical Ser., No. 32, 297 p.
19. Kantorovich L.V. and Akilov G.P. *Funkcionalnyj analiz* (Functional analysis). Oxford, New York: Pergamon Press, 1982, 589 p.
20. Nikolski S.M. *Priblizhenie funkcij mnogih peremennyh i teoremy vlozheniya* (Approximation of functions of several variables and embedding theorems). Berlin: Springer, 1975, Die Grundlehren der Mathematischen Wissenschaften, Band 205, 418 p.
21. Stepanets A.I. Approximation of continuous periodic functions of many variables by spherical Riesz means. *Math. Notes*, 1974, vol 15, no. 5, pp. 492–498.
22. Schmeisser H.J., Triebel H. *Topics in Fourier analysis and function spaces*. Chichester: J. Wiley & Sons, 1987, 300 p.

*D. B. Bazarkhanov.*, Cand. Sci. (Phys.-Math.), Prof., Institute of Mathematics and Mathematical Modeling, 125 Pushkin str., Almaty, 050010 Kazakhstan, e-mail: dauren.mirza@gmail.com.

Cite this article as:

D. B. Bazarkhanov, The  $L_p$ -boundedness of some classes of pseudo-differential operators on the  $m$ -dimensional torus, *Trudy Inst. Mat. Mekh. UrO RAN*, 2016, vol. 22, no. 4, pp. 64–80.