

ON AN EIGENVALUE PROBLEM INVOLVING THE $p(x)$ -LAPLACE OPERATOR PLUS A NON-LOCAL TERM

MIHAI MIHĂILESCU AND DENISA STANCU-DUMITRU

Abstract. We study an eigenvalue problem involving variable exponent growth conditions and a non-local term, on a bounded domain $\Omega \subset \mathbb{R}^N$. Using adequate variational techniques, mainly based on the mountain-pass theorem of A. Ambrosetti and P. H. Rabinowitz, we prove the existence of a continuous family of eigenvalues lying in a neighborhood at the right of the origin.

Mathematics subject classification (2000): 35D05, 35J60, 35J70, 58E05, 68T40, 76A02.

Keywords and phrases: variable exponent growth conditions, non-local term, eigenvalue problem, mountain-pass theorem.

REFERENCES

- [1] E. ACERBI AND G. MINGIONE, *Regularity results for a class of functionals with nonstandard growth*, Arch. Rational Mech. Anal., **156** (2001), 121–140.
- [2] E. ACERBI AND G. MINGIONE, *Gradient estimates for the $p(x)$ -Laplacean system*, J. Reine Angew. Math., **584** (2005), 117–148.
- [3] A. AMBROSETTI AND P. H. RABINOWITZ, *Dual variational methods in critical point theory*, J. Funct. Anal., **14** (1973), 349–381.
- [4] Y. CHEN, S. LEVINE, AND R. RAO, *Variable exponent, linear growth functionals in image processing*, SIAM J. Appl. Math., **66** (2006), 1383–1406.
- [5] L. DIENING, *Theoretical and numerical results for electrorheological fluids*, Ph.D. thesis, University of Frieburg, Germany, 2002.
- [6] D. E. EDMUNDS, J. LANG, AND A. NEKVINDA, *On $L^{p(x)}$ norms*, Proc. Roy. Soc. London Ser. A, **455** (1999), 219–225.
- [7] D. E. EDMUNDS AND J. RÁKOSNÍK, *Density of smooth functions in $W^{k,p(x)}(\Omega)$* , Proc. Roy. Soc. London Ser. A, **437** (1992), 229–236.
- [8] D. E. EDMUNDS AND J. RÁKOSNÍK, *Sobolev embedding with variable exponent*, Studia Math., **143** (2000), 267–293.
- [9] X. FAN, *Remarks on eigenvalue problems involving the $p(x)$ -Laplacian*, J. Math. Anal. Appl., **352** (2009), 85–98.
- [10] X. FAN, J. SHEN, AND D. ZHAO, *Sobolev embedding theorems for spaces $W^{k,p(x)}(\Omega)$* , J. Math. Anal. Appl., **262** (2001), 749–760.
- [11] X. L. FAN AND Q. H. ZHANG, *Existence of solutions for $p(x)$ -Laplacian Dirichlet problem*, Nonlinear Anal., **52** (2003), 1843–1852.
- [12] X. FAN, Q. ZHANG, AND D. ZHAO, *Eigenvalues of $p(x)$ -Laplacian Dirichlet problem*, J. Math. Anal. Appl., **302** (2005), 306–317.
- [13] X. L. FAN AND D. ZHAO, *On the spaces $L^{p(x)}(\Omega)$ and $W^{m,p(x)}(\Omega)$* , J. Math. Anal. Appl., **263** (2001), 424–446.
- [14] T. C. HALSEY, *Electrorheological fluids*, Science, **258** (1992), 761–766.
- [15] P. HARJULEHTO, P. HÄSTÖ, U. V. LÊ, AND M. NUORTIO, *Overview of differential equations with non-standard growth*, preprint.
- [16] O. KOVÁČIK AND J. RÁKOSNÍK, *On spaces $L^{p(x)}$ and $W^{1,p(x)}$* , Czechoslovak Math. J., **41** (1991), 592–618.

- [17] M. MIHĂILESCU AND G. MOROŞANU, *Existence and multiplicity of solutions for an anisotropic elliptic problem involving variable exponent growth conditions*, Applicable Analysis, in press.
- [18] M. MIHĂILESCU AND G. MOROŞANU, *On an eigenvalue problem for an anisotropic elliptic equation involving variable exponents*, submitted.
- [19] M. MIHĂILESCU, P. PUCCI, AND V. RĂDULESCU, *Eigenvalue problems for anisotropic quasilinear elliptic equations with variable exponent*, J. Math. Anal. Appl., **340** (2008), 687–698.
- [20] M. MIHĂILESCU AND V. RĂDULESCU, *A multiplicity result for a nonlinear degenerate problem arising in the theory of electrorheological fluids*, Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, **462** (2006), 2625–2641.
- [21] M. MIHĂILESCU AND V. RĂDULESCU, *On a nonhomogeneous quasilinear eigenvalue problem in Sobolev spaces with variable exponent*, Proc. Amer. Math. Soc., **135**, 9 (2007), 2929–2937.
- [22] M. MIHĂILESCU AND V. RĂDULESCU, *Continuous spectrum for a class of nonhomogeneous differential operators*, Manuscripta Mathematica, **125** (2008), 157–167.
- [23] J. MUSIELAK, *Orlicz spaces and modular spaces*, Lecture Notes in Mathematics, Vol. 1034, Springer, Berlin, 1983.
- [24] M. RUZICKA, *Flow of shear dependent electrorheological fluids*, C. R. Acad. Sci. Paris Ser. I Math., **329** (1999), 393–398.
- [25] M. RUZICKA, *Electrorheological fluids modeling and mathematical theory*, Springer-Verlag, Berlin, 2002.
- [26] S. SAMKO AND B. VAKULOV, *Weighted Sobolev theorem with variable exponent for spatial and spherical potential operators*, J. Math. Anal. Appl., **310** (2005), 229–246.
- [27] V. ZHIKOV, *Averaging of functionals in the calculus of variations and elasticity*, Math. USSR Izv., **29** (1987), 33–66.