

## STABILITY OF POSITIVE SOLUTIONS TO $p$ -LAPLACE TYPE EQUATIONS

J. TYAGI

*Abstract.* In this article, we first show the existence of a positive solution to

$$\begin{cases} -\Delta_p u - \alpha \Delta u = \lambda(u - f(u)) & \text{in } \Omega, \\ u = 0 & \text{on } \partial\Omega, \end{cases}$$

by the method of lower and upper solutions and then under certain conditions on  $f$ , we show the stability of positive solution.

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### REFERENCES

- [1] R. Aris, *Mathematical Modelling Techniques*, Research Notes in Mathematics, Pitman, London, 1978.
- [2] V. Benci and D. Fortunato, Solitary waves in classical field theory, *Nonlinear analysis and applications to physical sciences*, Springer Italia, Milan, 2004, 1–50.
- [3] D. Castorina, P. Esposito and B. Sciunzi, Spectral theory for linearized  $p$ -Laplace equations, *Nonlinear Anal.*, **74** (2011), 3606–3613.
- [4] D. Castorina, P. Esposito and B. Sciunzi, Low dimensional instability for semilinear and quasilinear problems in  $\mathbb{R}^N$ , *Commu. Pure Appl. Anal.*, **8** (2009)(6), 1779–1793.
- [5] D. Castorina, P. Esposito and B. Sciunzi, Degenerate elliptic equations with singular nonlinearities, *Calc. Var. P. D. E.*, **34** (2009), 279–306.
- [6] L. Cherfils, Y. Ilyasov, On the stationary solutions of generalized reaction-diffusion equations with  $p$ -Laplacian, *Commu. Pure Appl. Anal.*, **4** (2005)(1), pp. 9–22.
- [7] L. Damascelli, B. Sciunzi, Regularity, monotonicity and symmetry of positive solutions of  $m$ -Laplace equations, *J. Diff. Equations*, **206** (2004), 483–515.
- [8] L. Damascelli, B. Sciunzi, Harnack inequalities, maximum and comparison principles, and regularity of positive solutions of  $m$ -Laplace equations, *Calc. Var. P. D. E.*, **25** (2006), 139–159.
- [9] D. G. de Figueiredo, J. P. Gossez, P. Ubilla, Local “superlinearity” and “sublinearity” for the  $p$ -Laplacian, *J. Functional Anal.*, **257** (2009), 721–752.
- [10] G. H. Derrick, Comments on nonlinear wave equations as models for elementary particles, *J. Math. Physics* **5** (1964), 1252–1254.
- [11] E. Di Benedetto,  $C^{1+\alpha}$  local regularity of weak solutions of degenerate elliptic equations, *Nonlinear Anal.*, **7** (1983), 827–850.
- [12] P. Drábek, J. Hernández, Existence and uniqueness of positive solutions for some quasilinear elliptic problems, *Nonlinear Anal.*, **44** (2001), 189–204.
- [13] J.P. Fleckinger, P. Takáč, Maximum and anti-maximum principles for some elliptic problems, *Advances in differential equations and mathematical physics* (Atlanta, GA, 1997), 19–32, *Contemp. Math.*, 217, Amer. Math. Soc., Providence, RI, 1998.
- [14] P. Felmer, M. Montenegro, A. Quaas, A note on the strong maximum principle and the compact support principle, *J. Diff. Eqn.*, **246** (2009), 39–49.
- [15] C. He, G. Li, The existence of a nontrivial solution to the  $p$ -Laplacian problem with nonlinearity asymptotic to  $u^{p-1}$  at infinity in  $\mathbb{R}^N$ , *Nonlinear Anal.* **68** (2008), 1100–1119.

- [16] C. He, G. Li, The regularity of weak solutions to nonlinear scalar field elliptic equations containing  $p$  &  $q$ -Laplacians, *Ann. Acad. Sci. Fenn. Math.*, **33** (2008), no. 2, 337–371.
- [17] E.K.Lee, R.Shivaji, J.Ye, Positive solutions for elliptic equations involving nonlinearities with falling zeroes, *Appl. Math. Lett.* **22** (2009), No. 6, 846–851.
- [18] G. M. Lieberman, Boundary regularity for solutions of degenerate elliptic equations, *Nonlinear Anal.*, **12** (1988), 1203–1219.
- [19] M.K.V. Murthy, G. Stampacchia, Boundary value problems for some degenerate-elliptic operators, *Ann. Mat. Pura Appl.*, **80** (4) (1968), pp. 1–122.
- [20] H. R. Quoirin, An indefinite type equation involving two  $p$ -Laplacians, *J. Math. Anal. Appl.*, **387** (2012), pp. 189–200.
- [21] N. E. Sidiropoulos, Existence of solutions to indefinite quasilinear elliptic problems of  $p - q$ -Laplacian type, *Electronic J. Diff. Equations*, No. 162, (2010), pp. 1–23.
- [22] M. Struwe, *Variational Methods: Applications to Nonlinear Partial Differential Equations and Hamiltonian Systems*, Fourth Edition, Springer, 2007.
- [23] P. Tolksdorf, Regularity for a more general class of quasilinear elliptic equations, *J. Diff. Equations*, **51** (1984), 126–150.
- [24] N.S. Trudinger, Linear elliptic operators with measurable coefficients, *Ann. Scuola Norm. Sup. Pisa*, **27** (3) (1973), 265–308.
- [25] J. Tyagi, On an eigenvalue problem involving singular potential, *Complex Var. Elliptic Eqns*, Vol. 58, No. 6 (2013), 865–871.
- [26] J. Tyagi, A note on the stability of solutions to quasilinear elliptic equations, *Advances in Cal. Var.*, (to appear).