

L_p -solutions of a nonlinear third order differential equation and the Poincaré-Perron problem

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© 2018, Springer Nature Switzerland AG. In this paper we prove the well-posedness and we study the asymptotic behavior of nonoscillatory L_p -solutions for a third order nonlinear scalar differential equation. The equation consists of two parts: a linear third order with constant coefficients part and a nonlinear part represented by a polynomial of fourth order in three variables with variable coefficients. The results are obtained assuming three hypotheses: (1) the characteristic polynomial associated with the linear part has simple and real roots, (2) the coefficients of the polynomial satisfy asymptotic integral smallness conditions, and (3) the polynomial coefficients are in $L_p([t_0, \infty[))$. These results are applied to study a fourth order linear differential equation of Poincaré type and a fourth order linear differential equation with unbounded coefficients. Moreover, we give some examples where the classical theorems cannot be applied.