

一类含隅角和弯矩的奇异梁方程三个正解的存在性

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Existence of Triple Positive Solutions to a Class of Singular Beam Equations with Corner and Bending Moment

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摘要 利用格林函数方法和Avery-Peterson不动点定理研究了一类非线性四阶两点边值问题

$$\begin{cases} u^{(4)}(t) = f(t, u(t), u'(t), u''(t)), & 0 < t < 1, \\ u(0) = u'(1) = u''(0) = u'''(1) = 0 \end{cases}$$

多个正解的存在性, 其中允许非线性项 $f(t, u, v, w)$ 在 $t=0, t=1, u=0, v=0, w=0$ 处奇异. 在力学上该问题模拟了左端简单支撑右端被滑动夹子夹住的弹性梁的挠曲. 由于非线性项同时涉及隅角和弯矩, 因此主要结论对于梁的稳定性分析是有益的. 最后我们给出了一个例子, 进一步证实本文理论的严密性和可行性.

关键词: [弹性梁方程](#) [正解](#) [奇性](#)

Abstract: By applying the technique of Green function and a fixed point theorem due to Avery and Peterson, we studied the existence of triple positive solutions for a class of nonlinear fourth-order two-point boundary value problems:

$$\begin{cases} u^{(4)}(t) = f(t, u(t), u'(t), u''(t)), & 0 < t < 1, \\ u(0) = u'(1) = u''(0) = u'''(1) = 0 \end{cases}$$

where the nonlinear term $f(t, u, v, w)$ is allowed to be singular at $t = 0, t = 1, u = 0, v = 0, w = 0$. In mechanics, the problem describes an elastic beam simply supported at left and clamped at right by sliding clamps. Since the nonlinear term involve not only corner but also bending argument, main results are useful for the stability analysis of the beam. A detailed example is given to validate our results at last.

Key words: [an elastic beam equation](#) [positive solutions](#) [singularity](#)

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- [1] GUPTA C P. Existence and Uniqueness Theorems for the Bending of an Elastic Beam Equation. *Applicable Analysis*, 1988, 26(3): 289-304 
- [2] 吴红萍. 一类弹性梁方程三个正解存在性. *甘肃科学学报*, 2002(2): 9-11 (Wu Hongping. The Existence of Three Positive Solutions for an Elastic Beam Equation. *Journal of Gansu Sciences*, 2002(2): 9-11)
- [3] 吴红萍, 马如云. 一类四阶两点边值问题正解的存在性. *应用泛函分析学报*, 2000, 2(4): 342-348 (Wu Hongping, Ma Ruyun. Positive Solutions of Fourth-order Two-point Boundary Value Problem. *Acta Analysis Functionalis Applicata*, 2000, 2(4): 342-348)
- [4] Bai Zhanbing, WANG Haiyan. On Positive Solutions of Some Nonlinear Fourth-order Beam Equation. *J. Math. Anal. Appl.*, 2002, 270(2): 357-368 
- [5] YAO Qingliu. Existence of n Solutions and/or Positive Solutions to a Semipositone Elastic Beam Equation. *Nonlinear Anal.*, 2007, 66: 138-150 
- [6] 李永祥. 四阶边值问题正解的存在性与多解性. *应用数学学报*, 2003, 26(1): 109-116 (Li Yongxiang. Existence and Multiplicity of Positive Solutions for Fourth-order Boundary Value Problems. *Acta Mathematicae Applicatae Sinica*, 2003, 26(1): 109-116) 浏览
- [7] 姚庆六. 一类弹性梁方程的正解存在性与多解性. *山东大学学报 (理学版)*, 2004, 39(5): 64-67 (Yao Qingliu. Existence and Multiplicity of Positive Solutions to a Class of Elastic Beam Equations. *Journal of Shandong University (Natural Science)*, 2004, 39(5): 64-67)
- [8] 姚庆六, 江涛. 一类经典非线性弹性梁方程的正解. *郑州大学学报 (理学版)*, 2006, 38(1): 1-6 (Yao Qingliu, Jiang Tao. Positive Solutions to One Class of Classical Nonlinear Elastic Beam Equations. *Journal of Zhengzhou University (Natural Science Edition)*, 2006, 38(1): 1-6)
- [9] 白占兵. 某些四阶微分方程的迭代解. *系统科学与数学*, 2007, 27(4): 555-562 (Bai Zhanbing. The Iterative Solution for Some Fourth-order Differential Equations. *Journal of Systems Science and Mathematical Sciences*, 2007, 27(4): 555-562) 
- [10] 姚庆六. 一类含隅角和弯矩的梁方程的正解存在性与多解性. *兰州大学学报 (自然科学版)*, 2006, 42(4): 127-130 (Yao Qingliu. Existence and Multiplicity of Positive Solutions to a Class of Beam Equations with Corner and Bending Moment. *Journal of Lanzhou University*, 2006, 42(4): 127-130)
- [11] Avery R I. A Generalization of the Leggett-Williams Fixed Point Theorem. *Math Sci Res. Hot-Line*, 1999(3): 9-14
- [12] Anderson D. Multiple Positive Solutions for Three-point Boundary Value Problem. *Math. Comput. Modell.*, 1998, 27: 49-57 
- [13] Li FuYi, Zhang Yajing. Multiple Symmetric Nonnegative Solutions of Second-order Ordinary Differential Equations. *Applied Mathematics Letters*, 2004, 17: 261-267 
- [14] Zhao Dongxia, Wang Hongzhou, Ge Weigao. Existence of Triple Positive Solutions to a Class of p -Laplacian Boundary Value Problems. *J. Math. Anal. Appl.*, 2007, 328: 972-983 
- [15] Shu Xiaobao, Xu Yuantong. Triple Positive Solutions for a Class of Boundary Value Problems of Second-order Functional Differential Equations. *Nonlinear Anal.*, 2005, 61: 1401-1411 
- [16] Sun Bo, Ge Weigao, Zhao Dongxia. Three Positive Solutions for Multipoint One-dimensional p -Laplacian Boundary Value Problems with Dependence on the First Order Derivative. *Mathematical and Computer Modelling*, 2007, 45: 1170-1178 
- [1] 栾世霞, 赵艳玲. 带 p -Laplacian 算子的四点四阶奇异边值问题的对称正解[J]. *应用数学学报*, 2011, 34(5): 801-812.
- [2] 张红侠, 刘立山, 郝新安. 具有积分边界条件的四阶奇异特征值问题的正解[J]. *应用数学学报*, 2011, 34(5): 873-885.
- [3] 崔玉军, 孙经先. Banach空间中二阶微分方程三点边值问题的正解[J]. *应用数学学报*, 2011, 34(4): 743-751.
- [4] 王颖, 刘立山, 王永庆. 二阶奇异微分方程无穷边值问题[J]. *应用数学学报*, 2011, 34(4): 577-590.
- [5] 胡良根, 周先锋, 王金平. 奇异特征值问题正解的全局结构[J]. *应用数学学报*, 2011, 34(1): 139-148.
- [6] 栾世霞, 孙钦福. 一类二阶半正特征值问题的正解[J]. *应用数学学报*, 2011, 34(1): 10-16.
- [7] 闫东明. 一类四阶两点边值问题正解的存在性[J]. *应用数学学报*, 2010, 33(6): 1113-1122.
- [8] 张兴秋, 王新华. 半直线上具有 p -Laplacian算子的 Sturm-Liouville型脉冲边值问题的单调迭代正解[J]. *应用数学学报*, 2010, 33(5): 780-791.
- [9] 王霞, 戚仕硕, 陈芳启. 二阶差分边值问题的正解[J]. *应用数学学报*, 2010, 33(3): 547-558.
- [10] 解大鹏, 刘洋, 柏传志, 方明. 一类带有变号二阶四点奇异边值问题的正解[J]. *应用数学学报*, 2010, 33(1): 171-180.
- [11] 张兴秋. 奇异四阶积分边值问题正解的存在唯一性[J]. *应用数学学报*, 2010, 33(1): 38-50.
- [12] 张兴秋, 王新华. 半直线上具有 p -Laplacian算子的 Sturm-Liouville型脉冲边值问题的单调迭代正解[J]. *应用数学学报*, 2010, 33(1): 780-791.
- [13] 孙彦, 刘立山. 三阶奇异边值问题的正解[J]. *应用数学学报*, 2009, 32(1): 50-59.
- [14] 田元生. 三阶 p -Laplacian方程三点奇异边值问题三个正解的存在性[J]. *应用数学学报*, 2008, 31(6): 1118-1127.
- [15] 张丽颖, 王丽颖, 李晓月. 奇异二阶微分系统 Neumann边值问题的多重正解[J]. *应用数学学报*, 2008, 31(6): 1035-1045.

