

Yang, Yong-Ge; Sun, Ya-Hui; Xu, Wei

Bifurcation analysis of an energy harvesting system with fractional order damping driven by colored noise. (English) [Zbl 07443134](#)

Int. J. Bifurcation Chaos Appl. Sci. Eng. 31, No. 15, Article ID 2150223, 19 p. (2021)

MSC:

- 34C60 Qualitative investigation and simulation of ordinary differential equation models
- 78A55 Technical applications of optics and electromagnetic theory
- 34A08 Fractional ordinary differential equations
- 34F05 Ordinary differential equations and systems with randomness
- 34F10 Bifurcation of solutions to ordinary differential equations involving randomness
- 34C23 Bifurcation theory for ordinary differential equations
- 37C60 Nonautonomous smooth dynamical systems

Keywords:

fractional derivative; vibration energy harvester; colored noise; stochastic bifurcation

Full Text: [DOI](#)

References:

- [1] Bobryk, R. V. & Yurchenko, D. [2016] “On enhancement of vibration-based energy harvesting by a random parametric excitation,” *J. Sound Vibr.*366, 407-417.
- [2] Cao, J., Zhou, S., Inman, D. J. & Chen, Y. [2015] “Chaos in the fractionally damped broadband piezoelectric energy generator,” *Nonlin. Dyn.*80, 1705-1719.
- [3] Chen, Y. Q., Petras, I. & Xue, D. [2009] “Fractional order control — A tutorial,” 2009 American Control Conf. (IEEE), pp. 1397-1411.
- [4] Chen, L., Zhao, T., Li, W. & Zhao, J. [2016] “Bifurcation control of bounded noise excited Duffing oscillator by a weakly fractional-order \mathcal{P}^{λ} feedback controller,” *Nonlin. Dyn.*83, 529-539. · [Zbl 1349.93162](#)
- [5] Daqaq, M. F. [2011] “Transduction of a bistable inductive generator driven by white and exponentially correlated Gaussian noise,” *J. Sound Vibr.*330, 2554-2564.
- [6] Daqaq, M. F., Masana, R., Erturk, A. & Dane Quinn, D. [2014] “On the role of nonlinearities in vibratory energy harvesting: A critical review and discussion,” *Appl. Mech. Rev.*66.
- [7] Denoël, V. [2018] “Multiple timescale spectral analysis of a linear fractional viscoelastic system under colored excitation,” *Probab. Engin. Mech.*53, 66-74.
- [8] Di Matteo, A., Spanos, P. D. & Pirrotta, A. [2018] “Approximate survival probability determination of hysteretic systems with fractional derivative elements,” *Probab. Engin. Mech.*54, 138-146.
- [9] Dos Santos, K. R. M., Brudastova, O. & Kougioumtzoglou, I. A. [2020] “Spectral identification of nonlinear multi-degree-of-freedom structural systems with fractional derivative terms based on incomplete non-stationary data,” *Structural Safety*86, 101975.
- [10] Harne, R. L. & Wang, K. W. [2013] “A review of the recent research on vibration energy harvesting via bistable systems,” *Smart Mater. Struct.*22, 023001.
- [11] Huang, Z. L. & Jin, X. L. [2009] “Response and stability of a SDOF strongly nonlinear stochastic system with light damping modeled by a fractional derivative,” *J. Sound Vibr.*319, 1121-1135.
- [12] Huang, D., Zhou, S. & Litak, G. [2019] “Analytical analysis of the vibrational tristable energy harvester with a RL resonant circuit,” *Nonlin. Dyn.*97, 663-677. · [Zbl 1430.94109](#)
- [13] Jiang, W., Sun, P., Zhao, G. & Chen, L. [2019] “Path integral solution of vibratory energy harvesting systems,” *Appl. Math. Mech.*40, 579-590. · [Zbl 1416.70016](#)
- [14] Kitio Kwuimy, C. A., Litak, G. & Nataraj, C. [2015] “Nonlinear analysis of energy harvesting systems with fractional order physical properties,” *Nonlin. Dyn.*80, 491-501.
- [15] Li, W., Chen, L., Zhao, J. & Trisovic, N. [2018] “Reliability estimation of stochastic dynamical systems with fractional order PID controller,” *Int. J. Struct. Stab. Dyn.*18, 1850083.
- [16] Li, C. & Cai, M. [2019] *Theory and Numerical Approximations of Fractional Integrals and Derivatives* (SIAM).
- [17] Litak, G., Friswell, M. & Adhikari, S. [2010] “Magneto piezoelectric energy harvesting driven by random excitations,” *Appl.*

Phys. Lett.96, 214103.

- [18] Liu, Q., Xu, Y. \& Kurths, J. [2018] “ Active vibration suppression of a novel airfoil model with fractional order viscoelastic constitutive relationship,” *J. Sound Vibr.*432, 50-64.
- [19] Méndez, V., Campos, D. \& Horsthemke, W. [2013] “ Efficiency of harvesting energy from colored noise by linear oscillators,” *Phys. Rev. E*88, 022124.
- [20] Mokem Fokou, I. S., Nono Dueyou Buckjohn, C., Siewe Siewe, M. \& Tchawoua, C. [2017] “ Nonlinear analysis and analog simulation of a piezoelectric buckled beam with fractional derivative,” *The European Phys. J. Plus*132, 344. · [Zbl 1392.74049](#)
- [21] Mokem Fokou, I. S., Nono Dueyou Buckjohn, C., Siewe Siewe, M. \& Tchawoua, C. [2018] “ Probabilistic distribution and stochastic P-bifurcation of a hybrid energy harvester under colored noise,” *Commun. Nonlin. Sci. Numer. Simul.*56, 177-197. · [Zbl 07263235](#)
- [22] Niu, J., Liu, R., Shen, Y. \& Yang, S. [2019] “ Stability and bifurcation analysis of single-degree-of-freedom linear vibro-impact system with fractional-order derivative,” *Chaos Solit. Fract.*123, 14-23. · [Zbl 1448.34021](#)
- [23] Podlubny, I. [1994] “ Fractional-order systems and fractional-order controllers,” *Instit. Experim. Phys. Slovak Acad. Sciences, Kosice*12, 1-18.
- [24] Rossikhin, Y. A. \& Shitikova, M. V. [2009] “ Application of fractional calculus for dynamic problems of solid mechanics: Novel trends and recent results,” *Appl. Mech. Rev.*63.
- [25] Spanos, P. D., Di Matteo, A. \& Pirrotta, A. [2019] “ Steady-state dynamic response of various hysteretic systems endowed with fractional derivative elements,” *Nonlin. Dyn.*98, 3113-3124.
- [26] Sun, Z., Dang, P. \& Xu, W. [2019] “ Detecting and measuring stochastic resonance in fractional-order systems via statistical complexity,” *Chaos Solit. Fract.*125, 34-40. · [Zbl 1448.34120](#)
- [27] Sun, Y. H. \& Yang, Y. G. [2020] “ Stochastic averaging for the piezoelectric energy harvesting system with fractional derivative element,” *IEEE Access*8, 59883-59890.
- [28] Tran, N., Ghayesh, M. H. \& Arjomandi, M. [2018] “ Ambient vibration energy harvesters: A review on nonlinear techniques for performance enhancement,” *Int. J. Engin. Sci.*127, 162-185. · [Zbl 1423.74322](#)
- [29] Wang, J., Zhou, S., Zhang, Z. \& Yurchenko, D. [2019] “ High-performance piezoelectric wind energy harvester with Y-shaped attachments,” *Energy Convers. Manage.*181, 645-652.
- [30] Wang, J., Gu, S., Zhang, C., Hu, G., Chen, G., Yang, K., Li, H., Lai, Y., Litak, G. \& Yurchenko, D. [2020] “ Hybrid wind energy scavenging by coupling vortex-induced vibrations and galloping,” *Energy Conversion and Management*213, 112835.
- [31] Xu, M., Jin, X., Wang, Y. \& Huang, Z. [2014] “ Stochastic averaging for nonlinear vibration energy harvesting system,” *Nonlin. Dyn.*78, 1451-1459.
- [32] Xu, M. \& Li, X. [2019] “ Two-step approximation procedure for random analyses of tristable vibration energy harvesting systems,” *Nonlin. Dyn.*98, 2053-2066.
- [33] Yang, Y., Xu, W., Gu, X. \& Sun, Y. [2015] “ Stochastic response of a class of self-excited systems with Caputo-type fractional derivative driven by Gaussian white noise,” *Chaos Solit. Fract.*77, 190-204. · [Zbl 1353.34102](#)
- [34] Yang, X. J., Gao, F. \& Ju, Y. [2017a] “ Non-differentiable exact solutions for the nonlinear ODEs defined on fractal sets,” *Fractals*25, 1740002.
- [35] Yang, X. J., Machado, J. A. \& Nieto, J. J. [2017b] “ A new family of the local fractional PDEs,” *Fractals*151, 63-75. · [Zbl 1386.35461](#)
- [36] Yang, Y. G. \& Xu, W. [2018] “ Stochastic analysis of monostable vibration energy harvesters with fractional derivative damping under Gaussian white noise excitation,” *Nonlin. Dyn.*94, 639-648.
- [37] Yang, Y. G., Xu, W., Chen, Y. Q. \& Zhou, B. [2018] “ Bifurcation analysis of a vibro-impact viscoelastic oscillator with fractional derivative element,” *Int. J. Bifurcation and Chaos*28, 1850170-1-10. · [Zbl 1414.34042](#)
- [38] Yang, X. J. [2019] *General Fractional Derivatives: Theory, Methods and Applications* (CRC Press, NY). · [Zbl 1417.26001](#)
- [39] Yang, T. \& Cao, Q. [2019] “ Dynamics and energy generation of a hybrid energy harvester under colored noise excitations,” *Mech. Syst. Sign. Process.*121, 745-766.
- [40] Yang, X. J. \& Tenreiro Machado, J. A. [2019] “ A new fractal nonlinear Burgers’ equation arising in the acoustic signals propagation,” *Math. Meth. Appl. Sci.*42, 7539-7544. · [Zbl 1435.35412](#)
- [41] Yang, K., Wang, J. \& Yurchenko, D. [2019] “ A double-beam piezo-magneto-elastic wind energy harvester for improving the galloping-based energy harvesting,” *Appl. Phys. Lett.*115, 193901.
- [42] Yang, X. J. [2020a] “ New insight into the Fourier-like and Darcy-like models in porous medium,” *Thermal Sci.*24(6A), 3847-3858.
- [43] Yang, X. J. [2020b] “ On traveling-wave solutions for the scaling-law telegraph equations,” *Thermal Sci.*24(6B), 3861-3868.
- [44] Yang, X. J., Gao, F. \& Ju, Y. [2020] *General Fractional Derivatives with Applications in Viscoelasticity* (Academic Press, San Diego). · [Zbl 1446.26001](#)
- [45] Yildirim, T., Ghayesh, M. H., Li, W. \& Alici, G. [2017] “ A review on performance enhancement techniques for ambient vibration energy harvesters,” *Renew. Sustain. Energy Rev.*71, 435-449.
- [46] Yurchenko, D., Burlon, A., Di Paola, M., Failla, G. \& Pirrotta, A. [2017] “ Approximate analytical mean-square response of an impacting stochastic system oscillator with fractional damping,” *ASCE-ASME J. Risk Uncert. Engin. Syst. Part B: Mech. Engin.*3, 030903.
- [47] Zhang, J., Sun, Z., Yang, X. \& Xu, W. [2018] “ Controlling bifurcations in fractional-delay systems with colored noise,” *Int.*

J. Bifurcation and Chaos 28, 1850137-1-12. · [Zbl 1404.34089](#)

- [48] Zhang, Y., Jin, Y. & Xu, P. [2020] “Dynamics of a coupled nonlinear energy harvester under colored noise and periodic excitations,” *Int. J. Mech. Sci.* 172, 105418.

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.