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Abstract

We study stochastic resonance (SR) in an oscillator with nonlinear noise, fractional-order external damping, and fractional-order intrinsic damping. Using a moment equation, we derive the exact analytical expression of the output amplitude and find that fluctuations in the output amplitude are non-monotonic. Using numerical simulations we verify the accuracy of this analytical result. We find (i) that nonlinear noise plays a key role in system behavior and that the resonance of the output amplitude is diverse when there is nonlinear noise, (ii) that the order of the fractional-order damping strongly impacts resonant intensity and that the impact on resonant intensity of fractional-order external damping is opposite that of fractional-order intrinsic damping, and (iii) that the evolution of the output amplitude versus the frequency of the external periodic force exhibits three behaviors: a resonance with one peak, a resonance with one peak and one valley, and a resonance with one valley.

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