

# Chaotic Dynamics of the Fractionally Damped van der Pol Equation

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## Abstract

This paper deals with the harmonic oscillations of a periodically excited van der Pol system where hysteresis was simulated via fractional operator representations. The fractionally damped van der Pol equation was transformed into a set of fractional integral equations and solved by a predictor-corrector method. In particular, we focus on the effect of fractional damping on the dynamic behavior. The time evolutions of the nonlinear dynamic system responses are also described using phase portraits and the Poincare map technique. Results showed that the response of the system was very sensitive to changes in the order of fractional damping. Periodic, quasi-periodic, and chaotic motions existed when the order of fractional damping was less than 1. When the order of fractional damping exceeded 1, only chaotic motion was found among all simulations in this study. Moreover, two different strange attractors were also examined.

Keyword : Chaotic,  
van der Pol equation,  
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