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Letter to the Editor

He's Max-Min Approach to a Nonlinear Oscillator with Discontinuous Terms

Hui-Li Zhang and Fang Xie

Department of Mathematics, Kunming University, No. 2 Puxin Road, Kunming, Yunnan 650214, China

Correspondence should be addressed to Hui-Li Zhang; zhanghl1959@yahoo.com.cn

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Recently, the max-min approach was systematically studied in the review article (Ji-Huan, 2012). This paper concludes that He's max-min approach is also a very much effective method for nonlinear oscillators with discontinuous terms.

The ancient Chinese mathematics revives modern applications [1-8]; hereby, we show that He's max-min approach [1, 9-11] is also very effective for nonlinear oscillators with discontinuous terms.

The max-min approach was first proposed in 2008 based on an ancient Chinese mathematics, and it has become a well-known method for nonlinear oscillators; see, for example, [12–14]

To illustrate the basic idea of the max-min approach [1], we consider the following nonlinear oscillator:

$$u'' + \beta u^{3} + \varepsilon u |u| = 0, \quad u(0) = A, \quad u'(0) = 0.$$
 (1)

By a similar treatment as given in [1], we have

$$0<\omega^2<\beta A^2+\varepsilon A, \hspace{1cm} (2)$$

where ω is the unknown frequency.

According to an ancient Chinese inequality [1, 8, 10, 11], we have

$$\omega^{2} = \frac{n(\beta A^{2} + \varepsilon A)}{m+n}$$

$$= k(\beta A^{2} + \varepsilon A), \quad k = \frac{n}{(m+n)},$$
(3)

where m, n, and k are constants.

According to He's max-min approach, we set

$$\int_{0}^{T/4} \left(k \left(\beta A^{2} + \varepsilon A \right) u - \beta u^{3} - \varepsilon u |u| \right) \cos \omega t dt = 0,$$

$$T = \frac{2\pi}{\omega},$$
(4)

or

$$\int_{0}^{T/4} \left(k \left(\beta A^{2} + \varepsilon A \right) A \cos \omega t - \beta A^{3} \cos^{3} \omega t - \varepsilon A \cos \omega t | A \cos \omega t | \right) \cos \omega t dt = 0,$$
(5)

from which the frequency ω can be determined approximately as

$$\omega = \sqrt{\frac{3}{4}\beta A^2 + \frac{8}{3\pi}\varepsilon A},\tag{6}$$

which is the same as that obtained by the homotopy perturbation method [15].

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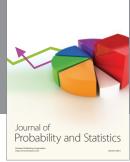
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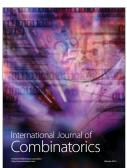














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