Letter to the Editor

Comment on “A New Second-Order Iteration Method for Solving Nonlinear Equations”

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Kang et al. claimed that they obtained a new iteration formulation for nonlinear algebraic equations; however the “new” formulation was first derived in 2007 by the variational iteration method.

Recently Kang et al. studied the following algebraic equation:

$$x = g(x) \quad (1)$$

and obtained the following iteration formulation [1, Equation (13)]:

$$x_{n+1} = \frac{-x_n g'(x_n) + g(x_n)}{1 - g'(x_n)}, \quad g'(x_n) \neq 1. \quad (2)$$

Kang et al. claimed that this was a new iteration formulation [1]; however, a more general iteration formulation has appeared in 2007 [2].

Consider a nonlinear algebraic equation

$$f(x) = 0. \quad (3)$$

By the variational iteration method [2], the following iteration formulation was obtained [2, Equation (7)]:

$$x_{n+1} = x_n - \frac{h(x_n) f(x_n)}{h(x_n) f'(x_n) + h'(x_n) f(x_n)}, \quad (4)$$

$$h(x_n) f'(x_n) + h'(x_n) f(x_n) \neq 0,$$

where $h(x)$ is an auxiliary function.

Choosing $h(x) = 1$ and $f(x) = x - g(x)$ in (4), we have

$$x_{n+1} = x_n - \frac{x_n - g(x_n)}{1 - g'(x_n)} = \frac{-x_n g'(x_n) + g(x_n)}{1 - g'(x_n)}. \quad (5)$$

This is exactly (2).

Using the basic idea of the variational iteration method as illustrated in [2] (see (1)–(8) in [2]), we can construct an iteration formulation for (1) in the form

$$x_{n+1} = g(x_n) + \lambda (g(x_n) - x_n), \quad (6)$$

where λ is a Lagrange multiplier. To identify the multiplier, we set (see [2, Equation (4)])

$$\frac{dx_{n+1}}{dx_n} = g'(x_n) + \lambda (g'(x_n) - 1) = 0, \quad (7)$$

from which the multiplier can be identified, which is

$$\lambda = -\frac{g'(x_n)}{g'(x_n) - 1}. \quad (8)$$

This results in

$$x_{n+1} = g(x_n) - \frac{g'(x_n)}{g'(x_n) - 1} (g(x_n) - x_n)$$

$$= \frac{-g(x_n) + x_n g'(x_n)}{g'(x_n) - 1}. \quad (9)$$

Remark 1. Equation (9) is exactly (2) or (4) when $h(x) = 1$ and $f(x) = x - g(x)$.

Remark 2. Equation (7) is exactly equivalent to $g'_\theta(x) = 0$ in [1].

Remark 3. θ in [1] is exactly equivalent to the Lagrange multiplier in (7).

Remark 4. The derivation process is the same as that given in [2].

It can be concluded that the so-called new iteration method is a special case of He 2007 formulation; various modifications of Newton iteration formulations are available in [2–7].

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