NUMERICAL SOLUTION OF BRATU-TYPE EQUATIONS BY THE VARIATIONAL ITERATION METHOD

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Abstract
In this paper, the variational iteration method (VIM) is applied to obtain approximate analytical solution of Bratu-type equations without any discretization. Comparisons with the exact solutions reveal that VIM is very effective and convenient.

Keywords: Variational iteration method, Bratu’s problem, Boundary value problems, Initial value problems.

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1. Introduction
Nonlinear phenomena are of fundamental importance in various fields of science and engineering. The nonlinear models of real-life problems are still difficult to solve either numerically or analytically. There has recently been much attention devoted to the search for better and more efficient solution methods for determining a solution, approximate or exact, analytical or numerical, to nonlinear models, [27, 21, 26].

In this paper, we consider the Bratu’s boundary value problem in one-dimensional planar coordinates in the form

\[ u'' + \alpha e^u = 0, \quad 0 < x < 1, \quad \alpha > 0, \]
\[ u(0) = u(1) = 0, \]

which is used to model a combustion problem in a numerical slab.

Several numerical techniques, like the Adomain decomposition method (ADM) [28], the one-dimensional differential transform method [10], the finite difference method, finite element approximation, weighted residual method [3], the shooting method [4], the Laplace Adomain decomposition method [25] and the Laplace transform decomposition

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