



Cover Page



PROFICIENT ITERATIVE METHOD FOR INITIAL AND BOUNDARY VALUE PROBLEMS ARISE IN ENGINEERING AND APPLIED SCIENCES

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ABSTRACT

The main aspire and contribution of this paper is to execute a semi-analytical iterative method proposed by Temimi and Ansari namely (TAM) to solve the Riccati, pantograph and elastic beam deformation equations, which appeared in models of various problems in engineering and applied sciences. The exact solutions are obtained for Riccati, Pantograph equations and an approximate solution for beam equation. The convergence of the TAM is investigated for the three problems. In general, the accuracy of our result for beam equation is better than those of Homotopy perturbation method (HPM) and Variational Iteration Method (VIM).

KEYWORDS: Differential Equations, Riccati Equation, Pantograph Equation, Elastic Beam Deformation Equations, Iterative Method.

I.INTRODUCTION

The linear and nonlinear differential equations play an important role in many problems that arise in various areas of physics, chemistry, engineering and applied science. The past few decades have seen significant advances to implement analytic, approximate and numerical methods for solving linear and nonlinear differential equations, earlier studies [31]. Several methods have applied to solve linear and nonlinear ODEs and PDEs such as the Adomian decomposition method (ADM) [1], the variational iteration method (VIM) [37], homotopy perturbation method (HPM) and differential transform method (DTM) [17]. Although these methods achieve some useful solutions, however, some drawbacks have been appeared such as calculate Adomian polynomial to deal with nonlinear



Cover Page



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terms in ADM, calculating Lagrange multiplier in VIM in which the terms of the sequence became complicated after several iteration, construct a homotopy and solve the corresponding equations in HPM. Riccati equation is an initial value problem of nonlinear

Riccati equation is an initial value problem of nonlinear differential equation which plays a significant role in many fields of applied science such as random processes, optimal control, diffusion problems, network synthesis and financial mathematics [7].

Also, pantograph equation is originated from the work of Ockendon and Tayler on the collection of current by the pantograph head of an electric locomotive [24]. The pantograph equations are appeared in modeling of various problems in engineering and sciences such as biology, economy, control and electrodynamics.

On the other hand, the beam deformation equation is a nonlinear boundary value problem (BVP) which is frequently used as mathematical model in viscoelastic, inelastic flows and deformation of beams [10, 38]. Recently, Temimi and Ansari have introduced a semi-analytical iterative method namely (TAM) for solving nonlinear problems [35]. The main feature of the TAM is doing not any required restricted assumptions to deal with nonlinear terms, time saver and has a higher convergence and accuracy. The TAM was inspired from the homotopy analysis method (HAM) [28] and it is one of the famous iterative methods that used for solving nonlinear problems [12]. Moreover, this method has been successfully applied to solve other different problems [19, 4-6]. In this article, the application of TAM for solving the Riccati, pantograph and elastic beam deformation equations will be presented. The efficiency and accuracy have been proved by studying the convergence and error analysis.

Our work in this paper is organized as follows; in section two the basic idea of the TAM is presented. The convergence of the TAM is discussed in section three. The scientific applications with some examples are introduced and solved in section four. Finally, the conclusion is given in section five.