

Approximate solution of fuzzy quadratic Riccati differential equations

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Abstract. This paper targets to investigate the solution of fuzzy quadratic Riccati differential equations with various types of fuzzy environment using Homotopy Perturbation Method (HPM). Fuzzy convex normalized sets are used for the fuzzy parameter and variables. Obtained results are depicted in term of plots to show the efficiency of the proposed method.

Keywords: fuzzy quadratic Riccati differential equation; fuzzy number; triangular fuzzy number; homotopy perturbation method

1. Introduction

Fuzzy differential equations have been expeditiously growing in recent years. Chang and Zadeh (1972) first introduced the concept of a fuzzy derivative, followed by Dubois and Prade (1982) who defined and used the extension principle in their approach. The fuzzy differential equation and fuzzy initial value problem are studied by Kaleva (1987, 1990) and Seikkala (1987). Numerical method for solving fuzzy differential equations is introduced by Ma *et al.* (1999) by the standard Euler method. Bede (2008) has also been described the numerical solution of fuzzy differential equations in his note in an excellent way. Chakraverty and Nayak (2012) implemented fuzzy finite element method for solving uncertain heat conduction problems. Recently Tapaswini and Chakraverty and Nayak (2012) have proposed a new method to solve fuzzy initial value problem. Different authors developed various other methods to solve fuzzy differential equations. Here we have considered Homotopy Perturbation Method (HPM) to solve fuzzy quadratic Riccati differential equation with different cases as it has many important applications in the analysis and design of linear periodic control systems.

Crisp quadratic Riccati differential equation is solved by various authors using different approximation method as reported here. Biazar and Eslami (2010) applied differential transform method to solve the equation. Tan and Abbasbandy (2008) discussed the solution of the said differential equation by the homotopy analysis method. Batiha (2012) proposed a numeric analytic method for approximating the quadratic Riccati differential equation. HPM is also used by Abbasbandy (2006a,b) to find the solution of quadratic differential equation. Aminikhah and Hemmatnezhad (2010) have also adopted new form of homotopy perturbation method for solving

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that the HPM is a powerful mathematical tool to solve fuzzy quadratic Riccati differential equation. It is also a promising method to solve other nonlinear equation. The solutions obtained are shown graphically. In our work, we use Mathematica package to calculate the series obtained from HPM.

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