Article

Fuzzy Sumudu Transform for Solving System of Linear Fuzzy Differential Equations with Fuzzy Constant Coefficients

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Abstract: In this paper, we employ fuzzy Sumudu transform for solving system of linear fuzzy differential equations with fuzzy constant coefficients. The system with fuzzy constant coefficients is interpreted under strongly generalized differentiability. For this purpose, new procedures for solving the system are proposed. A numerical example is carried out for solving system adapted from fuzzy radioactive decay model. Conclusion is drawn in the last section and some potential research directions are given.

Keywords: fuzzy Sumudu transform; fuzzy linear differential equations; system of fuzzy differential equations

MSC: 34A07, 65R10, 34A30

1. Introduction

For centuries, scientists have struggled to model real world phenomenon effectively and precisely. Among several modelling tools, scientists prefer to construct their models based on system of linear differential equations involving initial value problems [1–5]. This is because this kind of modelling are easier to be solved and analysed. However, the drawback of this modelling is very obvious and it is far from ideal. This is resulting from the lack of our knowledge about the world. Uncertainties or imprecisions occur in almost every aspect in our life, especially when dealing with real life phenomenon such as microbes, air and population. Using ordinary differential equations, the uncertainties are not dealt accordingly, thus, this leads to an inexact model.

To handle this shortcoming, scientist make use of Zadeh fuzzy set theory where the author emphasized that a number can be classified into certain membership function rather than we represent it as a discrete or crisp number [6]. The new modelling tool is referred to as fuzzy differential equations (FDEs). FDEs are developed whenever the structure of the model is non probabilistic. Unlike ordinary differential equations, FDEs take accounts the uncertainties or imprecisions observed circulating around the problem. There are a vast literature that can be found discussing FDEs as well as fuzzy derivatives [7–12].

So, the effort to construct methods for solving FDEs become an urgent matter. This includes both analytical and numerical methods. However, before we develop numerical methods for dealing with FDEs, it is important for us to construct analytical methods.

Recently, Ahmad and Abdul Rahman [13,14], proposed fuzzy Sumudu transform (FST) for solving FDEs with fuzzy initial values which was done under the strongly generalized differentiability concept. The authors successfully introduced some of FST fundamental properties and theories, and later demonstrated the proposed method on several numerical examples. As stated by the authors, the advantage of FST is significant as it reduces the complexity of the calculation when handling FDEs.