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Solution of Conformable Fractional Ordinary Differential Equations via Differential Transform Method

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Abstract

Recently, a new fractional derivative called the conformable fractional derivative is given which is based on the basic limit definition of the derivative in [1]. Then, the fractional versions of chain rules, exponential functions, Gronwall's inequality, integration by parts, Taylor power series expansions is developed in [2]. In this paper, we give conformable fractional differential transform method and its application to conformable fractional differential equations.

Key words : Conformable Fractional Derivative, Fractional power series, Conformable Fractional Differential Transform Method, Conformable Fractional Ordinary Differential Equations

1. Introduction

Despite becoming a popular topic in recent years, the concept of fractional derivatives has emerged in the late 17th century. Several definitions have been made to define the fractional derivative and continues to be done. Most popular definitions in this area are the Riemann-Liouville, Caputo and Grunwald-Letnikov definitions. These definitions are defined as, respectively,

(I) Riemann Liouville definition:

$$D_x^\alpha f(x) = \frac{1}{\Gamma(n-\alpha)} \left(\frac{d}{dx}\right)^n \int_0^x (x-t)^{n-\alpha-1} f(t) dt, \quad n-1 < \alpha \leq n$$

(II) Caputo definition:

$$D_x^\alpha f(x) = \frac{1}{\Gamma(n-\alpha)} \int_0^x (x-t)^{n-\alpha-1} f^{(n)}(t) dt, \quad n-1 < \alpha \leq n$$

(III) Grunwald-Letnikov definition:

$${}_a D_x^\alpha f(x) = \lim_{h \rightarrow 0} h^{-\alpha} \sum_{j=0}^{\frac{x-a}{h}} (-1)^j \binom{\alpha}{j} f(x-jh)$$

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