Dynamics of Continuous, Discrete and Impulsive Systems Series A: Mathematical Analysis 25 (2018) 319-328 Copyright ©2018 Watam Press

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EXISTENCE AND UNIQUENESS RESULTS FOR FRACTIONAL PANTOGRAPH EQUATIONS INVOLVING ψ -HILFER FRACTIONAL DERIVATIVE

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Abstract. In this paper, we discuss the existence and uniqueness results for nonlocal initial value problems for pantograph equations with ψ -Hilfer fractional derivative.

Keywords. ψ -Hilfer fractional derivative, Nonlocal condition, Existence, Uniqueness, Pantograph equation.

AMS (MOS) subject classification: 26A33, 34A08, 34A12, 45G05

1 Introduction

Functional differential equations with proportional delays are usually referred to as pantograph equations. In the following years, the pantograph equation became a prime example for a delay differential equation. The pantograph equations has been well studied over the last several decades, we refer the readers to [1, 4, 6, 12]. The fractional calculus is an extension of the classical calculus of arbitrary orders. Fractional calculus is more than three centuries old, but it has received much attention in recent years, see [5, 7]. Fractional derivatives developed in the past era namely, Grunwald-Letnikov, Erdlyi-Kober, Riesz, Riemann-Liouville, Caputo, Hadamard and Hilfer are just a few. Many researchers dabbled in the fractional derivatives and their analysis can be seen in [3, 9, 15]. In recent times, new fractional derivatives and it has been studied extensively by some researchers [8]. Further a new fractional derivative which is known as ψ -Hilfer fractional derivative was introduced by Vanterler and Capelas de Oliveira, which unifies several fractional definition and a brief note can be seen in [11]. In [14], Vivek et al. studied the existence and stability results for fractional pantograph equations via Hilfer fractional derivative. Motivated by above work, we discuss nonlocal initial value problems for pantograph equations with ψ -Hilfer fractional derivative