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A COUPLED CAPUTO–HADAMARD FRACTIONAL DIFFERENTIAL SYSTEM WITH MULTIPOINT BOUNDARY CONDITIONS

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Abstract. This paper deals with existence of solutions for a coupled system of Caputo–Hadamard fractional differential equations with multipoint boundary conditions in Banach spaces. Some applications are made using some fixed point theorems on Banach spaces. An illustrative example is presented in the last section.

Keywords. Fractional differential equation, coupled system, mixed Hadamard integral of fractional order, Caputo–Hadamard fractional derivative, solution, fixed point.

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1 Introduction

Fractional calculus has recently been applied in various areas of engineering, mathematics, physics, bio-engineering, and other applied sciences [20]. For some fundamental results in the theory of fractional calculus and fractional differential equations, we refer the reader to the monographs of Abbas et al. [2, 4, 5], Samko et al. [19], Kilbas et al. [16], and Zhou [22], and the papers [7–9, 11, 14, 21] and the references therein.

In [1, 3], the authors studied some classes of fractional differential equations involving the Caputo–Hadamard fractional derivative. The paper [1] deals with the existence of solutions for the Cauchy problem of the Caputo–Hadamard fractional problem

$$\begin{cases} \left({}^{\mathrm{HC}}D_1^r u\right)(t) = f(t, u(t)), \quad t \in [1, \infty), \\ u(t)|_{t=1} = \phi \in E, \end{cases}$$