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# GENERAL SOLUTION OF THE SINGULAR FRACTIONAL FORNASINI-MARCHESINI LINEAR SYSTEMS

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**Abstract.** The purpose of this research is to compute the solution of two dimensional singular systems expressed by Fornasini-Marchesini models. A new result using some $2D$ transforms is given. The goal of this study is to discuss the applicability of the fundamental matrix and delta Kronecker to solve this class of system. The derived results are then compared with the existing the solution formula for the standard models. All the obtained study results are expressed numerically to demonstrate the validity and effectiveness of the proposed method.

**Keywords.** Fractional linear systems, Caputo derivative, Double Laplace transform, Fornasini-Marchesini models, Fundamental matrix, Singular systems.

**AMS (MOS) subject classification:** 26A33, 35R11, 45F15 , 37N35, 58E25.

# 1 Introduction

In the last few decades, the class of singular fractional model has been meticulously and well studied; it has various applications in solving different problems in dynamic systems theory. The authors in [10, 12, 1] shows us their applicability in different fields of mathematics and science technology. In fact, singular systems have a wide range of applications, circuit analysis [12], neural networks and deep learning also in electric power systems [4, 18, 23].

In control theory, the fractional-order differential equations based on the Caputo derivative are have received and attracted a considerable interest in many fields of applied mathematics and science, epidemiology and engineering, signal processing, and digital image processing [2, 5, 6, 11, 25, 17, 22]. Actually, the researchers are interested to study the class of singular fractional systems and various methods have been proposed for resolving this models, and among the tools used for the resolution of this class of systems are the Kronecker-Weistress decomposition expressed and developed in a different case such us in the work [11, 10, 24], Luenberger shuffle algorithm