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Identification of Linear Fractional Systems of Commensurate Order

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Abstract—The identification of fractional order systems is a more difficult problem than the integer one because it requires not only the estimation of the model coefficients but also the determination of the fractional orders with the tedious calculation of fractional order derivatives. This paper addresses the identification of linear fractional systems of commensurate order. The proposed identification method is based on the recursive least squares algorithm applied to a linear regression equation derived from the linear fractional order differential equation using adjustable fractional order differentiators. The proposed technique does not require a prior knowledge of the commensurate order of the fractional linear differential equation. The derived formulations of the identification scheme are presented. Illustrative examples are also presented to validate the proposed identification approach.

I. INTRODUCTION

derivatives at each trial. Hence, the proposed method does not require a prior knowledge of the order of the linear fractional differential equation. Therefore, the fractional commensurate order value is obtained among several values as the one whose square error between the measured data and the estimated model is the smallest one. The basic derived formulations of the identification scheme are presented. Illustrative examples are given to validate the proposed identification approach for the linear fractional systems of commensurate order.

II. PRELIMINARIES

A. Linear fractional order systems

A linear single input single output (SISO) fractional system of commensurate order is described by the following linear fractional differential equation [18]: