Fractional Calculus and Applied Analysis
https://doi.org/10.1007/s13540-022-00014-6

ORIGINAL PAPER

Optimal *F*-domain stabilization technique for reduction of commensurate fractional-order SISO systems

Shibendu Mahata[1] · **Norbert Herencsar**[2] · **Baris Baykant Alagoz**[3] · **Celaleddin Yeroglu**[3]

Received: 13 December 2021 / Revised: 27 February 2022 / Accepted: 28 February 2022

Abstract

This paper presents a new approach for reduction of commensurate fractional-order single-input-single-output systems. The minimization in the frequency response error of the reduced order model (ROM) relative to the original system is carried out in the F-plane. A constrained optimization technique is introduced to satisfy the angle criteria for F-domain stability of the proposed ROM. Significant improvements in both the time- and frequency-responses over the recently published literature are illustrated using several numerical examples.

Keywords Fractional-order system (primary) · Commensurate system · F-domain · Model order reduction · Optimization · Reduced order model · Stability

Mathematics Subject Classification 26A33 · 93C10 · 93C80 · 93E99

✉ Norbert Herencsar
herencsn@vut.cz

Shibendu Mahata
shibendu.mahata@bcrec.ac.in

Baris Baykant Alagoz
baykant.alagoz@inonu.edu.tr

Celaleddin Yeroglu
c.yeroglu@inonu.edu.tr

1 Department of Electrical Engineering, Dr. B. C. Roy Engineering College, Durgapur, West Bengal 713206, India

2 Department of Telecommunications, Faculty of Electrical Engineering and Communication, Brno University of Technology, Technicka 12, 616 00 Brno, Czechia

3 Department of Computer Engineering, Faculty of Engineering, Inonu University, 44000 Malatya, Turkey

Published online: 25 March 2022