

2022 IEEE Calcutta Conference

IEEE KOLKATA SECTION
CALCON 2022

10 - 11 December, 2022, Jadavpur, Kolkata, India



PROCEEDINGS

ISBN: 978-1-6654-6241-9

PART: CFP22O01-USB

Organised by
IEEE Kolkata Section



2022 IEEE Calcutta Conference



10 - 11 December, 2022 Jadavpur, Kolkata, India

PROCEEDINGS

ISBN: 978-1-6654-6241-9

PART: CFP22O01-USB

**Organised by
IEEE Kolkata Section**



Table of Contents

Sl. No.	Paper ID	Authors' Name	Paper Title	Pages
		Benjamin A Shimray	Grid systems.	
48	118	Naiwrita Borah, Sai Pratyush Varma P, Ashis Datta , Amish Kumar, Udayan Baruah and Palash Ghosal	Performance Analysis of Breast Cancer Classification from Mammogram Images Using Vision Transformer	239-244
49	119	Souvik Roy, Milan Mukherjee, Priyadarsini Sinha, Sukanta Das, Subhasis Bandopadhyay and Abhik Mukherjee	Can social media represent an emerging event - case study on Indian citizenship debate	245-249
50	125	Mou Das Mahapatra, Shibendu Mahata, Ritu Rani De (Maity), Rajani Kanta Mudi and Chanchal Dey	Optimal Biquadratic Approximation of the Fractional-Order Laplacian Operator Yielding Improved Constant-Phase Behavior	250-255
51	129	Abhiram Alayil, Pallabi Sarkar, Dipanjan Bose and Chandan Kumar Chanda	Prediction of Power Outage During Cyclone Using Machine Learning	256-261
52	131	Amrita Thapa, Sutapa Debbarma and Bijoy Kumar Upadhyaya	Design of a Raspberry Pi Based Electronic Travel Assistant for Visually Impaired Persons	262-267
53	134	Arijit Bhadra and Suman Samui	Design and Analysis of High-Throughput Two-Cycle Multiply-Accumulate (MAC) Architectures for Fixed-Point Arithmetic	268-273
54	138	Kiron Nandi, Riddhi Ghosh, Biswendu Chatterjee and Sovan Dalai	Identification of Multiple Power Quality Disturbances based on Median Filter	274-278
55	141	Samayan Bhattacharya, Sk Shahnawaz, Avigyan Bhattacharya, Asraful Islam	Detection of Psychological Trauma in Refugee Children by Analysis of Drawings using Machine Learning	279-283
56	144	Kunal Pradhan, Swarnajyoti Patra	Structure Preserving Semantic Texture Filtering	284-288
57	145	Asif Iqbal Middy, Sarbani Roy	Predicting Missing Value for Ozone Data Based on Optimal Site-Selection Strategy	289-293
58	146	Sounak Banerjee, Sarbani Roy and Sunirmal Khatua	Game Theory Based Energy-aware Virtual Machine Placement towards Improving Resource Efficiency in Homogeneous Cloud Data Center	294-299
59	147	Biswajit Mandal and Partha Sarathee Bhowmik	Dye Sensitized Solar Testing by an improved resistive load method topology with raspberry pi- A cost effective novel approach	300-303
60	151	Shubhrajyoti Moitra and Kaushik Das Sharma	Adaptive Backstepping Control Scheme for Duffing-Holmes Chaotic System with Unknown Disturbances	304-308
61	154	Susanta Mondal, Sananda Pal, Anibrata Ghosh and Subir Kumar Sarkar	Design a Hardware model of RFID based Tracking System for Bird Flu affected Chickens	309-313
62	156	Moumita Pramanik, Uttiya Roy Konika Das Bhattacharya and	Effects of X/R on the Power Dynamics of a Rural Distribution System and the economic	314-318

Optimal Biquadratic Approximation of the Fractional-Order Laplacian Operator Yielding Improved Constant-Phase Behavior

Mou Das Mahapatra

Dept. of Electrical Engineering
Dr. B. C. Roy Engineering College
Durgapur, India
mou.dasmahapatra@bcrec.ac.in

Shibendu Mahata

Dept. of Electrical Engineering
Dr. B. C. Roy Engineering College
Durgapur, India
shibendu.mahata@bcrec.ac.in

Ritu Rani De (Maity)

Dept. of Electrical Engineering
Dr. B. C. Roy Engineering College
Durgapur, India
riturani.de@bcrec.ac.in

Rajani Kanta Mudi

Dept. of Instrumentation and Electronics Engineering
Jadavpur University
Kolkata, India
rkmudi@yahoo.com

Chanchal Dey

Dept. of Applied Physics
University of Calcutta
Kolkata, India
cdaphy@caluniv.ac.in

Abstract—This paper deals with the biquadratic approximation of the fractional-order Laplacian operator s^α , where, $\alpha \in (0, 1)$. The coefficients of the proposed rational function are optimally determined using an efficient constrained evolutionary algorithm. The proposed design constraint helps to attain the theoretical phase value of $\alpha\pi/2$ radians at the center frequency. Results showcase improved constant phase behavior for the proposed optimal approximants as compared to the models based on two different versions of the continued fraction expansion technique and the Sanathanan-Koerner curve-fitting method.

Index Terms—constrained composite differential evolution, fractional Laplacian operator, fractional-order system, optimization, rational approximation

I. INTRODUCTION

The dynamical behaviour of a real-world system can be mathematically modeled using differential equations. Such equations are based on the traditional definitions of the differential and integral operators (also known as the differintegrals), which are the two fundamental operators of the integer-order calculus. The physical and geometrical interpretations of the differintegrals are also well-known to the scientific community. However, the generalization of classical calculus, where the order of the differintegral operator can be any number – integer or non-integer, real or complex, and rational or irrational, had its roots dated 300 years back. This branch of mathematics is known as the non-integer order calculus, or more popularly the fractional calculus [1]. Studies in various fields reveal that better representations of systems are obtained by describing their dynamics using the fractional-order (FO) differ-integrals, instead of the conventional integer-order ones [2].

Fractional derivative satisfies the following properties: (i) if the function is analytic, its derivative must also be analytic; (ii) for an integer type order, the FO derivative provides the same result as an ordinary derivative; (iii) a function's zeroth-order

derivative results in no change; (iv) the fractional derivative operator is linear; and (v) for function $f(t)$, $D^\alpha D^\beta f(t) = D^{\alpha+\beta} f(t)$, for any α and β [3].

Several definitions of the FO derivative exist in the fractional calculus literature. The Caputo definition, as given by (1), may be preferred since it employs integer-order initial conditions [4].

$$D_{t_0}^\alpha f(t) = \frac{1}{\Gamma(m-\alpha)} \int_{t_0}^t (t-\tau)^{m-\alpha-1} f^{(m)}(\tau) d\tau \quad (1)$$

where $f(t)$ is a causal function; $m-1 < \alpha \leq m$, and m is an integer. If the initial conditions are zero, then the Laplace transform of (1) is $s^\alpha F(s)$.

There is no consensus among researchers regarding the physical interpretation of the fractional differintegrals, such as the area under the curve or slope of the tangent line at a point [5]. However, the importance of fractional calculus can be understood by considering a simple example, such as the FO differentiation of a periodic function $f(t) = \sin(t)$, as given by (2).

$$D_t^\alpha f(t) = \frac{d^\alpha}{dt^\alpha} \{\sin(t)\} = \sin\left(t + \frac{\alpha\pi}{2}\right) \quad (2)$$

From (2), it can be inferred that the phase of the sine function varies proportionately with the order of differentiation. If $\alpha = 1$, then the classical relation $\frac{d}{dt} \sin(t) = \cos(t)$, is obtained.

A rational approximation of the FO Laplacian operator s^α helps transform a fractional-order transfer function (FOTF) into an integer-order system. A biquadratic transfer function can be represented as per (3).

$$H(s) = \frac{p_2 s^2 + p_1 s + p_0}{p_0 s^2 + p_1 s + p_2} \quad (3)$$