People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research

University of Kasdi Merbah Ouargla

Faculty of Mathematics and Matter Sciences

Mathematics Department

1st International Conference on Pure and Applied Mathematics

IC-PAM'21, May 26-27, 2021, Ouargla, Algeria (Virtual conference)

CERTIFICATE OF PARTICIPATION

The organizing committee of the first International Conference on Pure and Applied Mathematics IC-PAM'21 May 26-27, 2021, Ouargla, Algeria, certifies that:

Kaouther BOUCHAMA

Presented an **ORAL COMMUNICATION** entitled:

Fractional Differential Equations Of Caputo-Hadamard Type And Numerical Solutions

Chairman of the IC-PAM'21

Dr. Abdelkader AMARA

1st International Conference on Pure and Applied Mathematics IC-PAM'21 Ouargla, Algeria Mai 26-27, 2021

FRACTIONAL DIFFERENTIAL EQUATIONS OF CAPUTO-HADAMARD TYPE AND NUMERICAL SOLUTIONS

KAOUTHER BOUCHAMA, ABDELKRIM MERZOUGUI, AND YACINE ARIOUA

Abstract. This paper is concerned with a numerical method for solving generalized fractional differential equation of Caputo-Hadamard derivative. A corresponding discretization technique is proposed. Numerical solutions are obtained and convergence of numerical formula is discussed. The convergence speed arrives at $O(h^{1-\alpha})$. Numerical examples are given to test the accuracy.

2010 Mathematics Subject Classification. 65C20, 34A08, 26A33.

Keywords and phrases. Numerical method, Fractional differential equations, Caputo-Hadamard fractional derivative.

1. Define the problem

In this paper, we consider a numerical technique for the fractional differential equation of Caputo–Hadamard type:

$$\begin{cases} {}^{CH}\mathcal{D}^{\alpha}_{a^+}u\,(t) + cu(t) = f(t),\ 0 < a \le t \le b < \infty \\ u(a) = u_a \end{cases} \tag{1}$$

Where ${}^{CH}\mathcal{D}^{\alpha}$ denotes the Caputo-Hadamard fractional derivative operator of order $\alpha \in (0, 1]$.The discrete implicit Euler formula is applied to obtain an approximate sequence for (1). In the first case, the equidistance partition is used to obtain a discrete version of the Caputo-Hadamard derivative, then the numerical formula and the numerically solve of the fractional differential equation are obtained.

References

[1] Y. Arioua, N. Benhamidouche, Boundary value problem for Caputo-Hadamard fractional differential equations, *Surveys in Mathematics and its Applications*. Vol. 12 (2017), 103–115.
[2] C. Chang-ming, F. Liu, K. Burrage, Finite difference methods and a fourier analysis for fractional reaction–subdiffusion equation, *Appl. Math. Comput*, 198 (2008) 754–769.
[3] K. Diethelm, *The Analysis of Fractional Differential Equations,* Springer Berlin (2010).
[4] R. Hilfer, *Applications of Fractional Calculus in Physics*, World Scientific, Singapore, (2000).
[5] A.A. Kilbas, H.H. Srivastava, J.J. Trujillo, *Theory and Applications of Fractional Differential Equations*, Elsevier Science B.V, Amsterdam, (2006).
[6] F. Jarad, D. Baleanu, A. Abdeljawad. Caputo-type modification of the Hadamard fractional derivatives. *Adv. Differ. Equ* . 2012, 142 (2012).
[7] R.L. Magin, Fractional Calculus in Bioengineering, Begell House Publishers, (2006).
[8] C.A. Monje, Y.Q. Chen, B.M. Vinagre, D. Xue, V. Feliu, *Fractional-Order Systems and Controls, Advances in Industrial Control*, Springer, (2010).
[9] I. Petras, *Fractional-Order Nonlinear Systems*, Springer, New York, (2011).

The First Online International Conference on Pure and Applied Mathematics

Ouargla University, Algeria, May 26-27, 2021, Algeria time

Final Program

Modeling and numerical analysis

27.05.2021- ROOM A Modeling and numerical analysis				GOOGLE MEET
09:00-14:30	Chair: Abdelmalek Boussaad			
	Hour	Activity Name	Title	Email
	9:00-09:15	Mohammed Said Souid	EXISTENCE OF SOLUTIONS FOR NONLINEAR HILFER-KATUGAMPOLA FRACTIONAL DIFFERENTIAL INCLUSIONS	souimed2008@yahoo.com
	9:15-09:30	Hadj Kaddour Tayeb	Blow-up results for fractional damped wave equations with nonlinear memory	hktn2000@yahoo.fr
	9:30-09:45	Amina Faraoun	Calculating the H infinity norm for a new class of fractional state space systems	amina.faraoun.etu@univ-mosta.dz
	9:45-10:00	Rachid Bouajaji	Contrôle optimal d'un modèle mathématique du Covid19: Cas discret	bouajajirachid@gmail.com
	10:00-10:15	Nidal Dib	CONVERGENCE OF FINITE VOLUME MONOTONE SCHEMES FOR STOCHASTIC GENERALIZED BURGERS EQUATION ON A BOUNDED DOMAINS	Dib_Nidal@yahoo.com
	10:15-10:30	NADIA MOHDEB	QUALITATIVE ANALYSIS OF AN EPIDEMIC MODEL WITH NONLINEAR INCIDENCE RATE IN THE TIME OF COVID-19	nadia.mohdeb@univ-bejaia.dz
	10:30-10:45	ABDERREZAK KASRI	SLIP DEPENDENT FRICTION IN QUASISTATIC VISCOPLASTICITY	kariabdezak@gmail.com
	10:45-11:00	Samia Khelladi	Etude comparative entre deux méthodes hybrides du gradient conjugué avec recherche linéaire inexacte	samia.boukaroura@univ-setif.dz
	11:00-11:15	PAUSE		
	11:15-11:30	Naaima Latioui	Existence and Uniqueness for a system of Klein-Gordon Equations	loubnalatioui@gmail.com
	11:30-11:45	Smail Kaouache	Existence du hyperchaos dans un nouveau système de Rabinovich d'ordre fractionnaire avec un seul terme non linéaire	smailkaouache@gmail.com
	11:45-12:00	Khaoula Saffidine	Existence Result of Positive Solution for a Degenerate parabolic System via a Method of Upper and Lower Solutions	khaoulasaffidine1994@gmail.com
	12:00-12:15	Fatima Zohra Sidi Ali	Feedback boundary stabilization of the Schrödinger equation with interior delay	f.sidiali@univ-batna2.dz
	12:15-12:30	Kaouther Bouchama	Fractional differential equations of Caputo-Hadamard type and numerical solutions	kaouther.bouchama@univ-msila.dz
	12:30-12:45	Abdelkader Laiadi	Free surface flows over a two obstacles by using series method	laiadhi_a@yahoo.fr
	12:45-13:00	Nouria Arar	Galerkin Approximation of the Diffusion-Reaction Equation by cubic B-Splines	nour.arar@yahoo.fr
	13:00-13:15	PAUSE		
	13:15-13:30	Noura Louzzani	Chaotic behavior in the product of generating functions	nlouzzani@gmail.com
	13:30-13:45	Chaima Bekhdidja	Euler approximation for stochastic differential equation driven by Brownian motion	chaima9maths@gmail.com
	13:45-14:00	Radia Touhami	Stochastic differential equation driven by fractional Brownian motion with Hurst parameter H >1/2 and Young integral	Touhamiradia30@gmail.com
	14:00-14:15	Hayet Djeghbal	Galerkin Approximation for some elliptic partial differential equations-Stochastic case	hayetdjeghbal@gmail.com
	14:15-14:30	Hana Bechoua	Stochastic differential equation perturbed by Poisson Noise	Hanabechoua11@gmail.com