

ICRAMCS 2026

THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON
RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 23-24-25, 2026 | Marrakech, Morocco



A Spline Quasi-Interpolant Method for the Time-Fractional Heat Equation

Communication Info

Authors:

Chaimae MOUHOU¹
Amal BOUAICHA¹
Mohamed LAMNII¹

¹ University Mohammed First,
Oujda, Morocco

Keywords:

- (1) Time-fractional heat equation
- (2) Caputo derivative
- (3) Spline quasi-interpolant

Abstract

This work introduces a numerical technique for solving the time-fractional heat equation by combining spline quasi-interpolants for spatial discretization with a Caputo fractional derivative in time. The method employs high-order, locally constructed splines in space alongside an L1-type finite difference scheme for the temporal component, allowing Dirichlet, Neumann, and mixed boundary conditions to be treated consistently. Numerical experiments show that the approach is accurate and stable, with errors decreasing as the spatial mesh is refined. While Dirichlet boundaries achieve the highest precision, Neumann and mixed conditions also perform reliably, demonstrating the method's versatility and effectiveness for fractional diffusion problems.

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