

## Theoretical and numerical aspect of fractional differential equations with purely integral conditions

### ABSTRACT

In this paper, we are interested in the study of a Caputo time fractional advection–diffusion equation with nonhomogeneous boundary conditions of integral types  $\int_{\Omega} v(x,t) dx$  and  $\int_{\Omega} x v(x,t) dx$ . The existence and uniqueness of the given problem's solution is proved using the method of the energy inequalities known as the “a priori estimate” method relying on the range density of the operator generated by the considered problem. The approximate solution for this problem with these new kinds of boundary conditions is established by using a combination of the finite difference method and the numerical integration. Finally, we give some numerical tests to illustrate the usefulness of the obtained results.

**Keyword:** Fractional derivatives; Caputo derivative; Fractional advection–diffusion equation; Finite difference schemes; Integral conditions