

Optimal Collocation Nodes for Fractional Derivatives

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Spectral discretizations of fractional derivative operators of Caputo type are examined, when the approximation basis is related to the set of Jacobi polynomials. The pseudo-spectral method is implemented by assuming that the grid, used to represent the function to be differentiated, may not be coincident with the collocation grid. The new option opens the path to the analysis of alternative techniques and to the search of optimal distributions of collocation nodes, based on the operator to be approximated. Once the initial representation grid has been chosen, indications on how to recover the collocation grid are provided, with the aim of enlarging the dimension of the approximation space. This process results in an improvement of performances.

Applications to a fractional type advection-diffusion equation are considered. Comparisons in terms of accuracy and efficiency are made between the proposed method and the standard ones.