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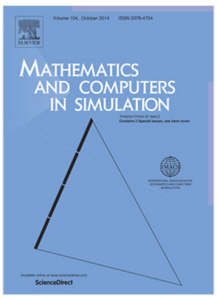

A multiscale collocation method for fractional differential problems

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A multiscale collocation method for fractional differential problems

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Abstract

We introduce a multiscale collocation method to numerically solve differential problems involving both ordinary and fractional derivatives of high order. The proposed method uses multiresolution analyses (MRA) as approximating spaces and takes advantage of a finite difference formula that allows us to express both ordinary and fractional derivatives of the approximating function in a closed form. Thus, the method is easy to implement, accurate and efficient. The convergence and the stability of the multiscale collocation method are proved and some numerical results are shown.

Keywords: Fractional differential problem, Collocation method, Fractional derivative, Fractional refinable function

1. Introduction

Fractional Calculus generalizes to positive real order the well-understood notion of derivative and integral of integer order (see, for instance, [19, 24, 26] and references therein). Even if the development of fractional calculus has a long history dating back to the 18th century, its use in real world applications has become popular just in more recent years. Indeed, in the last decades fractional differential problems are extensively used to model phenomena arising in several fields, from physics to continuum mechanics, from signal processing to electrochemistry, from biophysics to control theory. For instance, different kinds of fractional differential equations have been recently

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