Recent advances in the numerical solution of fractional differential equations

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Abstract

The numerical solution of fractional differential equations has gained more and more attention in the last years, due to their increasing use in the applications. Numerical software, aimed at solving such equations, has to cope with a number of intrinsic difficulties stemming from the possible non-smoothness of the solution, and/or the vector field, at the initial point. Moreover, the non-locality of the operator poses additional challenges due to the fact that, at any point, the solution depends on all its past values and, consequently, the computational cost increases.

Recently, a class of methods, named *Fractional HBVMs (FHBVMs)* has been derived for the efficient numerical solution of fractional differential equations of Caputo type. In case of an integer derivative, such methods reduce to HBVMs, a class of Runge-Kutta methods formerly devised for the efficient numerical solution of Hamiltonian problems. The basic idea, on which these latter methods rely on, is the local expansion of the vector field along the Legendre orthonormal polynomial basis which, in the case of a fractional derivative, becomes a suitable orthonormal Jacobi polynomial one, from which FHBVMs are derived.

In this talk, we shall recall the main facts about FHBVMs, which have been implemented in two Matlab codes, also showing their effectiveness through comparisons with existing Matlab solvers.

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