A class of spectral methods for deterministic and stochastic fractional differential equations.

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In time fractional models, the solution depends on all its past history; therefore such models are able to describe many evolutionary problems with memory. On the other hand, the numerical simulation by step-by-step methods (typically finite difference schemes) is computationally expensive. As a matter of fact, step-by-step methods represent a local approach, while fractional derivatives can be seen as global operators. In this perspective, we propose a spectral approach, which is a global scheme and avoids the discretization of the heavy tail of the solution at each time step. Moreover, spectral methods may exhibit an exponential error decay for a suitable choice of the spectral basis functions, while step-by-step methods usually have low order of convergence. In this talk, we illustrate a class of spectral methods for time fractional diffusion systems and for stochastic differential equations. We construct these methods and illustrate the linear steps which constitute their computational kernel. Then, we show their effectiveness on some test problems. Finally, we draw some conclusions and suggest possible developments.