Project of National Natural Science Foundation of China: High efficient spectral methods for non-local equations,

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Abstract：

In many cases, the non-local models which include the fractional derivativesand integrals are more naturally to modeling the memory and hereditary properties inherent in various materials and processes. The non-localoperators appearance produce much difficulties in analytically and numerically investigate the fractional integro-differential equations. The spectral methods is a high accurate numerical method which approximate the solution

globally, and it suit for numerical resolve the non-local problems. In this project, we will develop the high order numerical schemes, including the spectral methods and spectral element methods, for some selected non-local equations, such as Volterra-type integro-differential equations with singular kernel or delay, time, space and time-space fractional dynamical systems involving fractional derivatives. The stability and convergence of the spectral methods will be studied. We also design the adaptive algorithm and fast method by applying the interpolation postprocessing, correction

technique, and extrapolation. We will also consider the application to some practical problem in fluid dynamics and materials science. These work will further expand the basic theories of spectral methods and enrich the numerical methods of integro-differential equations and fractional differential equations.