A comparison of numerical methods and implementation algorithms for the direct numerical simulation in fluid dynamics

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In this paper we consider the Runge-Kutta discontinuous Galerkin method [1] with the polynomials of k-order, $k = \overline{0,4}$ and three-stage strong stability preserving Runge-Kutta scheme [2], resulting in the $k+1$ order of accuracy in space and third order of accuracy in time at the smooth solutions [1]. For the high-performance implementation of the numerical method, two approaches are supposed. First is the theory of locally-recursive non-locally asynchronous algorithms of implementation [3]. It is designed for the structured hexahedral grids and helps to increase the computational intensity of memory-bound stencil computations closer to the compute-bound ones. Second is the adaptive mesh refinement technique, which simply reduces the number of numerical cells where the high grid resolution is not necessary [4]. Optimal solver parameters concerning both the scheme and the algorithm are studied. The work is supported by Russian Science Foundation, grant 18-71-10004.

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[2] Gottlieb S, Shu C W and Tadmor E 2001 *SIAM review* **43** 89–112
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