Domain Decomposition Approaches for the Multiscale Discontinuous Galerkin Methods.

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We consider the computational and technological features of the parallel domain decomposition approaches for solving the systems of linear algebraic equations with symmetric and non-symmetric large sparse matrices of the special block structures which arise in high order approximations of the multi-dimensional and multiscale initial boundary value problems in the complicated computational domains with the piece-wise smooth multi-connected boundaries and high-contrast material properties, by means of discontinuity Galerkin methods on the quasi-structured grids. The problem is solved on the multi-processor computational system with distributed and hierarchical shared memory, by means of the tools of hybrid programming in the framework of the library KRYLOV. The matrix is saved in the memory of the different processors. Numerical methods are based on the two-level preconditioned iterative processes in the Krylov subspaces. The high efficiency and performance of the algorithms are provided by the balancing decomposition with parameterized overlapping and interface conditions, as well as by coarse grid correction and aggregation procedures, on the base of low rank approximation of the original matrix. The conception of the integrated computational environment for the high performance mathematical modeling is discussed.