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Parallel Distributed Object-Oriented Model of Domain Decomposition

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Abstract: Domain decomposition is one of the efficient methods to solve the problems on complex geometries and large meshes with adaptive refinement. It reduces the computational costs to find the solution within given accuracy. In this case it is necessary to combine computational and geometrical models and map the algorithms to hardware software platforms. In present work it is suggested to use object-oriented approach and parallel distributed middleware. The object-oriented model of domain decomposition and adaptive finite element method is developed. All objects of the model are sorted into four groups:

- Modeling classes used to create and describe analytical model of the problem (nodes, elements, domains, boundary conditions, etc.).
- Numerical classes used to carry out the numerical operations and store the data (matrices, vectors, system of equations, graphs, etc.).
- Analytical classes used to perform the analysis of the problem (solution algorithms, integration schemes, boundary condition imposition, equation ordering methods, etc.)
- Domain Decomposition classes used in the analysis of the problem by domain decomposition (subdomains, subdomain equation solver, etc.), they are based on the objects of the first groups.

Inheritance, polymorphism and encapsulation enable to make experiments with new domain decomposition algorithms using different methods of domain partitioning, storing and solving of systems of equations, boundary conditioning, and, as to adaptive solution, various mesh refinements, error estimations, refinement criteria. At present substructuring, frontal, element-by-element and some other methods are implemented and tested. Different parallel distributed implementations of objects were examined on MPI and CORBA. As a result, parallel distributed component technique are suggested to develop object-oriented software for domain decomposition. It is based on CORBA, component model CCM, asynchronous method invocation AMI and encapsulation of MPI applications.

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