The Integration of CAD-systems and Generators of Unstructured 3D Mesh

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Finite element modeling begins with problem statement and draft study. Before producing the computational grid it's necessary to design the 3D object, to generate the elements and to define the boundary condition. The last sets the computational model apart from the graphic model. In mesh producing, assignment of input data to mesh generator is sufficiently difficult. Decoding the graphic data files (*.dwg, *.sat, *.igs etc.) is the most commonly used method. Not only do CAD-systems support any type of graphic files but they have the comprehensive facilities to operate 3D objects visually. Therefore it's expedient to use the graphic model in producing of the computational grid (to generate the elements and to define the boundary condition) with help of any 3D mesh generator answered the requirements.

The approach to the integration of CAD-systems and 3D mesh generators is taken into consideration in the work given. The power differences between their geometric kernels are the main problem during integration. Unlike CAD-system, mesh generator needs exhaustive description of the object, including solid and surface data.

A geometric kernel is the main part of a CAD-system. The geometric data a kernel of CAD-system operates is mainly destined to visualize elaborate design. Now there are two widely used geometric kernels: Parasolid ACIS.

Parasolid is the most hide-speed object-oriented geometric kernel. Parasolid provides solid modeling. CAD/CAM-systems based on Parasolid: SolidWorks (SolidWorks Corp.), Solid Edge Unigraphics Modeling (Unigraphics Solutions Inc.), IronCAD (VDS) etc.

ACIS is the object-oriented geometric C++ library, including wire-frame, surface and solid models, wide range of geometric operations to design and operate complex model. Furthermore, ACIS allows surface and solid modeling to join one to another. CAD/CAM-systems based on ACIS: AutoCAD 2000, Mechanical Desktop Autodesk Inventor (Autodesk Inc.), IronCAD (VDS), T-FLEX CAD (Top Systems) etc.

A geometric kernel is the integral part of the mesh generators too, but his main purpose is to completely describe the geometry taking all the necessary data to perform a mesh generation algorithm. The most suitable mesh generators have an object-oriented interface and an object-oriented geometric kernel.

The integrated system consists of following subsystems: AutoCAD, unstructured 3D mesh generator and integrator. The integrator consists of COM-object encapsulated C++ library of mesh generating and VBA-project connected with AutoCAD. Integrator's objects interacts by COM. The interaction is described in the following way.

- AutoCAD and VBA-project are activated simultaneously. When draft is being opened VBA-project is extending AutoCAD interface by inserting new menu items to configure and run the mesh generator.
- In AutoCAD environment the new document is opened to contain 3D mesh that will be generated.
- COM-object encapsulated C++ library of mesh generator takes the pointers to the geometric model and the container draft for mesh. Then the AutoCAD geometric model mapped on the generator geometric model. As a matter of face it's converting between two geometric formats. In this case it's possible because of geometrical kernels have equal power. COM technology and object-oriented approach allow to avoid hard programming to convert data by formatted files.
- On the design formatted as the set of C++ objects mesh generator produces the mesh.
- The mesh geometric model formed by mesh generator is mapped on AutoCAD form and copied into the container draft.

The integration of CAD-systems and mesh generators is the productive way to prepare the data for computing. This is of major practical importance to develop complex software systems. This approach is suggested to be used in the context of development of the high-performance finite-element application framework. Now the mapping of the numeric parameters on 3D mesh and handling of map data are being implementing.