GEOMETRY MODELING AND MESH GENERATION FOR *HP* FINITE ELEMENT METHOD

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The success of Finite Element (FE) or Boundary Element (BE) simulations depends much on a precise representation of the geometry and appropriate mesh generation method. The modeling and mesh generation issues become especially sensitive for adaptive methods where we strive for high accuracy of simulations. Our recent work focuses on geometric modeling and automatic mesh generation for the *hp*-adaptive FE methods. The recently rewritten and upgraded *Geometrical Modeling Package*[1] supports the construction of exact parameterizations for a general class of 2D (BEM) and 3D (FEM) manifolds in $\mathbb{R}$.

The package uses two techniques. The first one is the standard transfinite interpolation with linear blending functions. The second one is a unique technique of implicit parameterizations developed at TICAM. Once a topology information (connectivities) for a 3D manifold is known, i.e. the object can be partitioned into a FE like mesh of curvilinear hexahedra, the GMP constructs a parameterization for each hexahedron in the GMP mesh which later can be used to generate the actual FE meshes of arbitrary high order, and make geometry updates during mesh refinements. The bottleneck of the GMP package is the generation of the connectivities (topology info) for the GMP mesh. In this presentation, we will report on two pursued research directions to make the preparation of such data fully automatic. The first approach is based on an interface with *CUBIT*, a mesh generation software developed at Sandia National Labs. We use the STEP AP203 international standard to import a geometry input into CUBIT and our GMP package, and then run CUBIT to provide the necessary connectivities, with GMP constructing the actual parameterizations. The technique is used to generate the geometry models and corresponding *hp* meshes for complicated and interlocking assemblies related to Measuring While Drilling technologies. The work is done in collaboration with Dr. Timothy Tautges from Sandia and Dr. Adam Zdunek from the Swedish Aeronautical Institute.

References

[1] D. Xue, L. Demkowicz, "Geometrical Modeling Package. Version 2.0," *TICAM Report 02-30*, 2002.
[2] D. Xue, L. Demkowicz, "An Interface Between Geometrical Modeling Package(GMP) and Mesh-Based Geometry (MBG)," *ICES Report 03-20*, 2003.