Current & New Trends in Scientific Computing
October 5 - 9, 2009, CMM-DIM Universidad de Chile, Santiago, Chile

Some Issues related to Unstructured Mesh Generation

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Abstract

The development of mesh generation techniques has been underway for more than thirty years. Yet, lots of issues are still unsolved and some new ways are now starting to be explored. In this presentation, we will briefly discuss some of those issues and give an overview of our research in mesh generation.

Geometry - based analysis. In the early years, Computer Aided Design (CAD) systems were completely disconnected from mesh generation. Now, mesh generation procedures have to connect CAD systems in order to be able to deal with industrial applications. In the presentation, we will present an abstract CAD interface that enables both mesh generation and adaptation. Here, mesh adaptation will be performed on the real geometry: the issues related both to vertex snapping and to multi-dimensional mesh adaptation will be addressed. Not all geometries are defined through a CAD model, especially those coming from medical imaging. We will present some recent developments related to high quality surface meshing using harmonic mappings and to the automatic generation of cuts through numerical homology.

Curvilinear mesh generation. There is a growing consensus that state of the art Finite Volume technology requires, and will continue to require too extensive computational resources to provide the necessary resolution, even at the rate that computational power increases. In many contributions, it is shown that the accuracy of the method strongly depends of the accuracy of the geometrical discretization. In other words, the following question is raised: yes we have the high order methods, but how do we get the meshes? In the presentation, we then discuss the issues related to curvilinear mesh generation and present some recent developments that enable to build high order meshes in a robust way.

Anisotropic meshes for boundary layers. Anisotropic meshes are currently used for capturing shocks or discontinuities. We discuss here the usefulness of using anisotropic unstructured meshes for capturing boundary layers. The use of such meshes with FE or FV solvers is illustrated with some examples.

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