061 - Trends in Unstructured Mesh Generation

061 - 061 - Session 1: Trends in Unstructured Mesh Generation

No: 164

Title: Application of smoothing techniques for aligning meshes

Abstract: In this work we develop a method that deforms a given triangulation to obtain its alignment with interior curves. These curves, defined by splines, can represent internal interfaces between different materials, internal boundaries, etc. An important feature of this method is the possibility to adapt a reference mesh to curves that change their shape in the course of an evolutive process. The method is an extension of the surface mesh smoothing proposed in [2] in which the quality improvement of the mesh is obtained by an iterative process in which each node of the mesh is moved to a new position that minimizes a certain objective function. The objective function is derived from the algebraic quality measure [1] mean ratio extended to the local submesh, that is, set of triangles connected to the free node.

Suppose that C is a curve sited on a surface mesh S, the basic idea consists on projecting on C some nodes of S until getting an approximate representation (interpolation) of C by linked edges of S. A node is considered projectable if there exists a position on C for which its local submesh does not result tangled. This projection implies a displacement of some nodes from its original positions and, in general, has a negative effect on the quality of the triangles close to C. To avoid this decrease in quality, the remaining nodes are also displaced to new positions following the smoothing procedure of [2]. Both the projection of nodes on C and the smoothing procedure are carried on a two-dimensional parametric space that, in our case, is a plane in which S can be projected performing a valid mesh, that is, without inverted elements. Working on the parametric space is a crucial aspect of our algorithm because the presence of barriers in the objective function avoids overlapped meshes to appear. The task to determine if a node can be projected on C and, in affirmative case, which is its optimal position, is undertaken by an objective function that incorporates the modifications introduced in [3].

All these questions will be conveniently supported by examples. In particular, we present an application of a topographic mesh which is modified in order to outline of the coastal shores.

[1] Knupp PM. Algebraic mesh quality metrics. SIAM J Sci Comp 2001;23:193 218.
[2] Escobar JM, Montero G, Montenegro R, Rodríguez E. An Algebraic Method for Smoothing Surface Triangulations on a Local Parametric Space. Int. J. Numer. Meth. Engrg. 2006;66:740-760.
[3] Escobar JM, Rodríguez E, Montenegro R, Montero G, González-Yuste JM. Simultaneous untangling and smoothing of tetrahedral meshes. Comp Meth Appl Mech Eng 2003;192:2775-2787.

Comments:

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