INTERIOR NODE PLACEMENT IN SWEEPING

Micheal Scott[a], Ved Vyas[b], Steven Owen[c]
David White[c], Micheal Stephenson[c]

[a]Department of Civil and Environmental Engineering
Brigham Young University
368 CB, Provo, UT 84602
mas88@et.byu.edu

[b]CIEL Laboratory, Department of Mechanical Engineering
Carnegie Mellon University
5000 Forbes Ave, Pittsburgh, PA 15213
vsv@andrew.cmu.edu

[c]Computational Modeling Sciences Department
Sandia National Laboratories
PO Box 5800, Albuquerque, NM 87185-0847
sjowen@sandia.gov, drwhite@sandia.gov, mbsteph@sandia.gov

Hexahedral meshes are frequently needed for computational simulation in many application areas. For most practical applications, where well-shaped hexahedra are needed, mapping and sweeping algorithms are employed. While node placement methods for mapped meshing have been extensively studied, no such study has been done on sweeping algorithms. This work will examine several existing algorithms for determining node placement for sweeping and recommend an optimal solution.

Several methods for interior node placement for sweeping have been proposed in the literature. The first method, introduced by Staten et al. [1], uses a background triangulation of the loops on the boundary. Interior node locations are determined by transferring the triangulation to the intermediate layers. Common barycentric locations on the layers of triangles are used to determine node locations. In contrast to this method, a scheme which utilizes a traditional structured node placement scheme known as *Winslow* smoothing was introduced by Knupp [2] for sweeping node placement. This method treats each layer independently optimizing the node locations of the quadrilateral vertices. The third method, introduced by Blacker, et al.[3], first computes a transformation matrix **T** for all boundary nodes, P_s, on the source to equivalent boundary nodes, P_t, on the target. As a result of this transformation, a residual **R** can determined for each boundary node where, $P_t = P_s\mathbf{T}+\mathbf{R}$. Interior node locations are determined by computing a linear combination of the weighted residuals of nearby nodes on the boundary.

We examine the strengths and weaknesses of each of these methods and propose a solution that attempts to optimize the strengths of each method. Several examples and comparisons to existing solutions are shown.

References

[1] M.L. Staten, S.A. Canann and S.J. Owen, “BMSWEEP: Locating Interior Nodes During Sweeping", *7th International Meshing Roundtable*, Sandia National Labs, pp.7-18, October 1998.
[2] P. Knupp, “Winslow Smoothing On Two-Dimensional Unstructured Meshes", *Proceedings, 7th International Meshing Roundtable*, Sandia National Lab, pp.449-457, October 1998
[3] T. D. Blacker, "The Cooper Tool", *5th International Meshing Roundtable*, Sandia National Laboratories, pp.13-30, October 1996

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.