ANISOTROPIC ADAPTIVE MESHING AND LEVELSET METHOD FOR INTERFACE CAPTURING PROBLEMS

T. Coupez[†]

[†]Mines ParisTech, Center for Material Forming (CEMEF)
1 rue Claude Daunesse, 06904 Sophia Antipolis, France
[†]e-mail: thierry.coupez@ mines-paristech.fr

ABSTRACT

In this paper, we propose to calculate a continuous anisotropic metric field at each nodes of the domain following a non classical route. We first introduce the approximation tensor of the length distribution defined from the length of the edges. A natural metric field is then the inverse of the proposed naturally symmetric positive definite tensor. The error is evaluated along the edge direction using a simple one dimension analysis in association with a local natural interpolant operator. A new edge length distribution is calculated and therefore a metric field is redesigned at the mesh nodes [1]. The mesh is then optimized under the constraint of a fixed number of nodes and consequently the error is automatically well balanced. At this stage of this work, the method has been tested on a class of problems involving only the interpolation error.

For instance it shows to work directly for moving domain and free surface flow problems. To solve the free surface problem, the solver is based on a stable/stabilised finite element method, a multiphase approach and the convected level set method on which is applied the above anisotropic framework. The surface representations are clearly enhanced as well indirectly the conservation of Level Set. The simulation results seem to be never attained at such level of rendering and at low cost.

Several numerical examples will be given to demonstrate the ability of anisotropic unstructured meshes to adequately address the challenge of simulating industrial applications involving boundary layers, immersed surfaces, free surfaces and Level Set in 2D for demonstration and in 3D real life application.

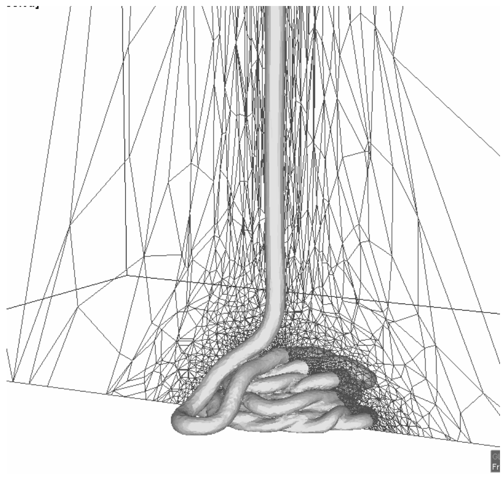

Figure 1: Fluid buckling simulation by the convected Level Set method with anisotropic adaptive meshing.

References

[1] T. Coupez, Continuous metric for anisotropic meshing, preprint for Journal of Computational Physics

[2] L. Ville, L. Silva., T. Coupez, “Convected level set method for the numerical simulation of fluid buckling”, Int. J. Numer. Meth. Fluids, accepted, 2009

[3] T. Gruau, T. Coupez, 3D tetrahedral, unstructured and anisotropic mesh generation with adaptation to natural and multidomain metric. Comput. Meth. Appl. Mech. Engrg., 194(48-49):4951-4976, 2005