数学与系统科学研究院

计算数学所学术报告

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报告题目：

Anisotropic Finite Element Mesh Adaptation via Higher Dimensional Embedding

邀请人：　崔涛 博士

报告时间：2015 年 7 月 23 日（周四）

下午 **16:00~17:00**

报告地点：　数学院南楼六层

602 会议室

Abstract:

In this talk we provide a novel anisotropic mesh adaptation technique for adaptive finite element analysis. It is based on the concept of higher dimensional embedding, which was exploited in [1-4] to obtain an anisotropic curvature adapted mesh that fits a complex surface in $\mathbb{R}^3$. In the context of adaptive finite element simulation, the solution (which is an unknown function $f : \Omega \subset \mathbb{R}^d \to \mathbb{R}$) is sought by iteratively modifying a finite element mesh according to a mesh sizing field described via a (discrete) metric tensor field that is typically obtained through an error estimator. We proposed to use a higher dimensional embedding, $\Phi_f({\bf x}) := (x_1,\, \ldots, x_d,\, s\, f(x_1,\, \ldots, x_d), s\, \nabla f(x_1,\, \ldots, x_d))^{\,t}$, instead of the mesh sizing field for the mesh adaption. This embedding contains both informations of the function f itself and its gradient. An isotropic mesh in this embedded space will correspond to an anisotropic mesh in the actual space, where the mesh elements are stretched and aligned according to the features of the function f. To better capture the anisotropy and gradation of the mesh, it is necessary to balance the contribution of the components in this embedding. We have properly adjusted $\Phi_f({\bf x})$ for adaptive finite element analysis. To better understand and validate the proposed mesh adaptation strategy, we first provide a series of experimental tests for piecewise linear interpolation of known functions. We then applied this approach in an adaptive finite element solution of partial differential equations. Both tests are performed on two-dimensional domains in which adaptive triangular meshes are generated. We compared these results with the ones obtained by the software BAMG -- a metric-based adaptive mesh generator. The errors measured in the L_2 norm are comparable. Moreover, our meshes captured the anisotropy more accurately than the meshes of BAMG.

Reference:

[1] G. D. Canas and S. J. Gortler. Surface remeshing in arbitrary codimensions. The Vis. Comp., 22(9-11):885–895, 2006.

[2] B. Levy and N. Bonneel, Variational anisotropic surface meshing with Voronoi parallel linear enumeration, Proceedings 21st International Meshing Roundtable, 2012, pp. 349–366.

[3] F. Dassi and H. Si, A curvature-adapted anisotropic surface re-meshing method, Tetrahedron IV Proceedings, 2014.

[4] F. Dassi A. Mola and H. Si, Curvature-adapted Remeshing of CAD Surfaces, Proceedings 23rd International Meshing Roundtable, Proc. Eng., 2014, 82, pp. 349–366.

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