The 18th International Conference on Finite Elements in Flow Problems (FEF2015)
16-18 March 2015, Taipei, Taiwan

IGA-SUITABLE NURBS PARAMETERIZATION OF COMPUTATIONAL DOMAIN WITH COMPLEX CAD BOUNDARY BY DOMAIN PARTITION AND ISOGEOMETRIC SOLVING

Gang Xu [1], Ming Li [2], Bernard Mourrain [3] and Stéphane P.A. Bordas [4]

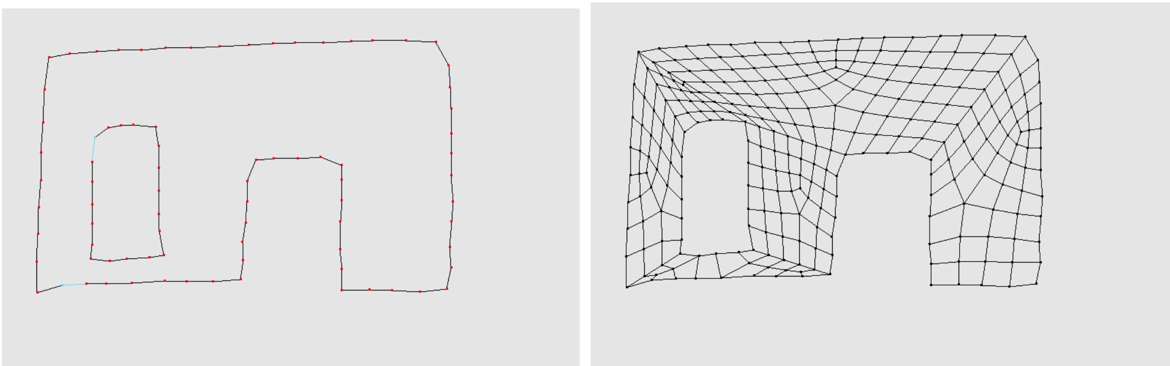
[1] Hangzhou Dianzi University, Hangzhou 310018, P.R China
xugangzju@gmail.com
[2] Zhejiang University, Hangzhou 310027, P.R China
eming.li@gmail.com
[3] GALAAD, INRIA Sophia-Antipolis, 2004 Route des Lucioles, 06902 Cedex, France
Bernard.Mourrain@inria.fr
[4] Université du Luxembourg and Cardiff University
stephane.bordas@gmail.com

Key words: *Isogeometric Analysis, Analysis-suitable Parameterization, Mesh Generation, Complex Boundary, Domain Partition*

Parameterization of computational domain in isogeometric analysis (IGA for short) plays an important role as mesh generation in Finite element analysis. In [4], the authors study the parametrization of computational domain in IGA, and show that the quality of parameterization has great impact on analysis results and efficiency. For parameterization problem with spline boundary, several approaches are proposed to construct planar/volume parameterization [1, 2, 3, 5]. However, constructing analysis-suitable parameterization from a complex CAD boundary representation remains one of the most significant challenges in isogeometric analysis.

In this presentation, we will propose a general framework to construct IGA-suitable planar NURBS parameterization from given complex CAD boundary consisting of NURBS curves. The main features of the proposed approach are:

- A robust planar domain partition framework is proposed to construct high-quality patch-meshing results with few singularities for computational domain with high genus and complex boundary curves. Figure.1 presents a quad-meshing example from discrete boundary formed by connecting the endpoints of input NURBS curves.



(a) Discrete boundary by connecting the endpoints of input NURBS curves

(b) Quad meshing by proposed domain partition method

Figure 1: Domain partition of computational domain.

- Isogeometric analysis method is employed to solve the variational problem arising from constructing IGA-suitable planar parameterization of computational domain. The objective function involved in the variational problem is related to the uniformity of planar domain partition and the quality measurement (such as injectivity, uniformity and orthogonality of iso-parametric structure) of patches with respect to each quad in the domain partition of computational domain.

The efficiency and robustness of the proposed method will be demonstrated by several examples in isogeometric applications. Some preliminary results on trivariate volumetric parameterization will also be presented.

REFERENCES

[1] M. Brovka, J. I. López, J. M. Escobar, J. M. Cascón, R. Montenegro. A new method for T-spline parameterization of complex 2D geometries. Engineering with Computers. 2014, 30(4):457-473.

[2] X. Wang, X. Qian. An optimization approach for constructing trivariate B-spline solids. Computer-Aided Design, 46(2014) 179-191.

[3] G. Xu, B. Mourrain, R. Duvigneau, A. Galligo. Analysis-suitable volume parameterization of multi-block computational domain in isogeometric applications. Computer-Aided Design, 45(2013), 395-404.

[4] G. Xu, B. Mourrain, R. Duvigneau, A. Galligo. Parameterization of computational domain in isogeometric analysis: methods and comparison. Computer Methods in Applied Mechanics and Engineering, 200(2011), 2021-2031.

[5] Y. Zhang, W. Wang, T. J.R. Hughes. Conformal solid T-spline construction from boundary T-spline representations. Computational Mechanics, 51(2013) 1051-1059.