Meshfree Methods and Isogeometric Analysis: Consistency Conditions,

Reproducing Kernel Unification and Local Refinement

Dongdong Wang^{*} and Hanjie Zhang

Department of Civil Engineering, Xiamen University, Xiamen, Fujian, 361005, China. *Corresponding author: ddwang@xmu.edu.cn

Abstract

Meshfree methods and isogeometric analysis are two classes of computational methods which have received significant attention and wide applications in recent years. In this presentation we discuss the consistency conditions for both meshfree methods with the reproducing kernel shape functions and isogeometric analysis with the B-spline basis functions [1]. It is systematically shown that unlike the reproducing kernel meshfree shape functions which meet the reproducing conditions with the nodal points as the reproducing locations, the monomial reproducing points for different orders of B-spline basis functions in isogeometric analysis are different. Meanwhile, a rational method is proposed to compute the reproducing points for Bspline basis functions in isogeometric analysis. Furthermore, we prove that after properly introducing meshfree nodes, support size and consistency conditions, the reproducing kernel meshfree shape functions are capable of exactly representing the isogeometric B-spline and NURBS basis functions. Thus a unified formulation is established for meshfree methods and isogeometric analysis [2]. Moreover, the proposed reproducing kernel meshfree representation of isogeometric basis functions provides a reliable meshfree strategy to the local model refinement in isogeometric analysis. This strategy inherits the strength of meshfree methods and gives considerable easiness for the local refinement, i.e., the shape functions in the refined regions can be naturally constructed in a straightforward meshfree manner. The effectiveness of the proposed framework is demonstrated through a series of numerical examples.

Keywords: Meshfree method; Isogeometric analysis; Reproducing kernel formulation; Consistency condition; Reproducing point; Local refinement

Acknowledgements: The support of this work by the National Natural Science Foundation of China (11472233, 11222221) is gratefully acknowledged.

References

- [1] Wang, D. and Zhang, H. (2014) A consistently coupled isogeometric-meshfree method, *Computer Methods in Applied Mechanics and Engineering*, **268**, 843–870.
- [2] Zhang, H. and Wang, D. (2017) Reproducing kernel formulation of B-spline and NURBS basis functions: A meshfree local refinement strategy for isogeometric analysis, *Computer Methods in Applied Mechanics and Engineering*, DOI: 10.1016/j.cma.2017.03.034.