

Announcement
of a Short Course on
ISOGEOMETRIC ANALYSIS

given by

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Technische Universität Wien, Karlsplatz 13, 1040 Vienna
Boecklsaal (1st Staircase, 1st Floor)

This October marks the tenth anniversary of the appearance of the first paper [1] describing a vision of how to address a major problem in Computer Aided Engineering (CAE). The motivation was as follows: Designs are encapsulated in Computer Aided Design (CAD) systems. Simulation is performed in Finite Element Analysis (FEA) programs. FEA requires the conversions of CAD descriptions to analysis-suitable formats from which finite element meshes can be developed. The conversion process involves many steps, is tedious and labor intensive, and is the major bottleneck in the engineering design-through-analysis process, accounting for more than 80% of overall analysis time, which remains an enormous impediment to the efficiency of the overall engineering product development cycle.

The approach taken in [1] was given the name *Isogeometric Analysis*. Since its inception it has become a focus of research within both the fields of FEA and CAD and is rapidly becoming a mainstream analysis methodology and a new paradigm for geometric design [2]. The key concept utilized in the technical approach is the development of a new foundation for FEA, based on rich geometric descriptions originating in CAD, resulting in a single geometric model that serves as a basis for both design and analysis.

In this short course I will introduce Isogeometric Analysis, describe some of the basic tools and methods, identify a few areas of current intense activity, and areas where problems remain open, representing opportunities for future research [3].

REFERENCES

[1] T.J.R. Hughes, J.A. Cottrell and Y. Bazilevs, *Isogeometric Analysis: CAD, Finite Elements, NURBS, Exact Geometry and Mesh Refinement*, Computer Methods in Applied Mechanics and Engineering, 194, (1 October 2005), 4135-4195.

[2] J.A. Cottrell, T.J.R. Hughes and Y. Bazilevs, *Isogeometric Analysis: Toward Integration of CAD and FEA*, Wiley, Chichester, U.K., 2009.

[3] *Isogeometric Analysis Special Issue* (eds. T.J.R. Hughes, J.T. Oden and M. Papadrakakis), Computer Methods in Applied Mechanics and Engineering, 284, (1 February 2015), 1-1182.

OUTLINE

1. Isogeometric Analysis
 - a. Background and brief history
2. B-splines, NURBS
 - a. Linear elasticity
 - i. Approximation theory
 - b. Spectral approximation
 - i. Vibrations
 - ii. Eigenvalue problems
 - c. Nearly-incompressible solids
 - d. Nonlinear solids
 - e. Shells (w/wo rotations)
 - f. Contact
 - g. Collocation
 - h. Reduced quadrature
 - i. Phase-field methods
 - j. Fluids and fluid-structure interaction
3. Analysis-suitable IGA Technologies
4. T-splines and Trimmed NURBS
 - a. Extraordinary points
 - b. Design-through-analysis
 - i. Surfaces
 - ii. Volumes
 - c. Boundary element methods
 - d. Hierarchical B-splines and immersed boundary methods
 - i. Solids
 - e. Phase-field modeling of crack propagation
 - i. Brittle fracture
5. Conclusions and Future Prospects

SCHEDULE

- 08:00 to 09:00 – Registration
- 09:00 to 10:30 – Lecture
- 10:30 to 11:00 – Break with light refreshments
- 11:00 to 12:30 – Lecture
- 12:30 to 14:00 – Lunch
- 14:00 to 15:30 – Lecture
- 15:30 to 16:00 – Break with light refreshments
- 16:00 to 17:30 – Lecture
- 17:30 to 18:30 – Reception