

## ISOGEOMETRIC ANALYSIS: TEN YEARS AFTER

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### ABSTRACT

This October marks the tenth anniversary of the appearance of the first paper [1] describing my 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 pithy 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 paradigm 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 talk I will describe areas in which progress has been made in developing improved Computational Mechanics methodologies to efficiently solve vexing problems that have been at the very least difficult, if not impossible, within traditional FEA. I will also describe current areas of intense activity and areas where problems remain open, representing opportunities for future research.

**Key Words:** *Computational Mechanics, Computer Aided Design, Finite Element Analysis, Computer Aided Engineering*

### 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, (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.