# Isogeometric analysis using splines on triangulations

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## ABSTRACT

Isogeometric Analysis (IgA) is a simulation paradigm aiming to reduce the gap between the worlds of Finite Element Analysis (FEA) and Computer-Aided Design (CAD). The main idea is to use the CAD representations not only to model physical domains but also to approximate the solution of differential problems. Tensor-product B-splines and Non-Uniform Rational B-Splines (NURBS) are common tools in CAD, and so they are in IgA.

Adaptive local mesh refinement is an important ingredient for obtaining efficiently an accurate solution of differential problems. In the context of classical FEA, local mesh refinement strategies are a well established procedure. Unfortunately, the tensor-product structure of NURBS spaces precludes strictly localized refinements. This motivates the interest in alternative structures for IgA that permit local refinements.

In this talk we discuss the use of splines on triangulations for the numerical solution of differential equations in the context of IgA. In particular, we focus on Powell–Sabin (PS) splines which are defined on triangulations with a particular macro-structure. These splines can be represented with basis functions possessing similar properties to the classical (tensor-product) B-splines. The PS B-splines form a convex partition of unity, and the coefficients of this representation have a clear geometric meaning. One can also easily define a rational extension of PS splines, so-called NURPS (Non-Uniform Rational PS). NURPS surfaces allow an exact representation of quadrics, and their shape can be locally controlled by control points and weights in a geometrically intuitive way.

Thanks to their structure based on triangulations, PS/NURPS splines offer the flexibility of classical finite elements with respect to local mesh refinements. Moreover, they share with standard tensor-product NURBS the increased smoothness, the B-spline-like basis, and the ability to exactly represent profiles of interest in engineering applications as conic sections. Therefore, they constitute a natural bridge between classical FEA and NURBS-based IgA. We will illustrate the use of PS/NURPS splines in IgA with several numerical examples [1, 2, 3].

## REFERENCES

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