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Design for *IGA*-type
discretization workflows



Funded by the
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DC6: Mathematical tools for immersed IGA



1st Technical Workshop (E1)

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Outline

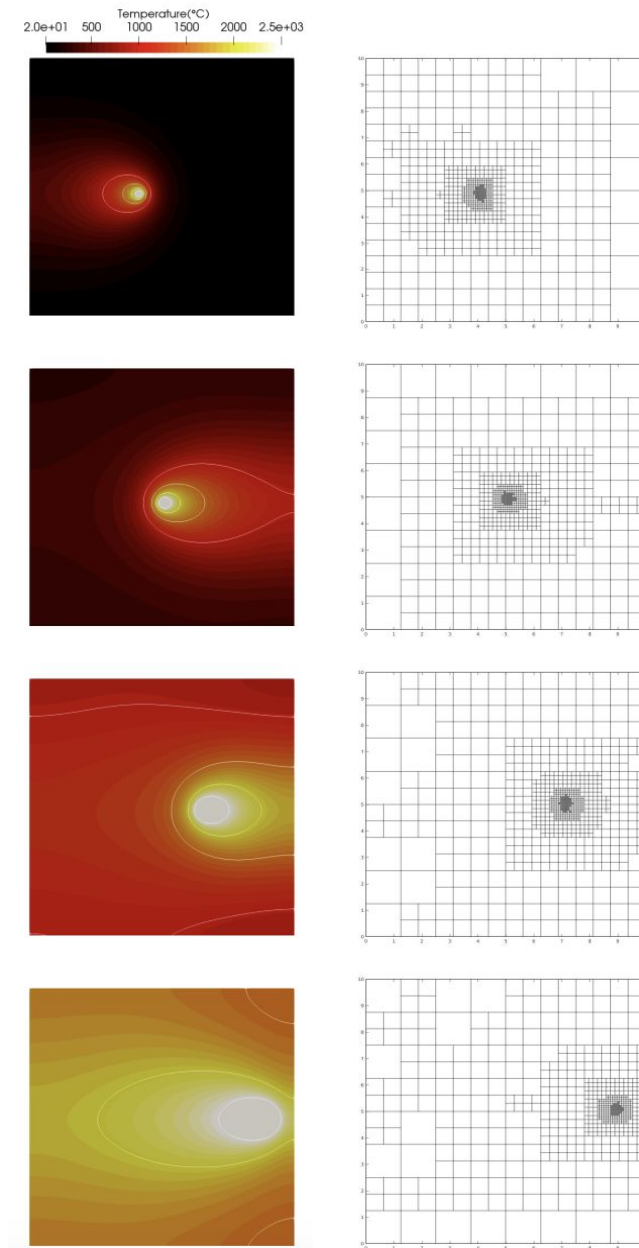
- Overview
- Literature review
- Next steps



Overview

Mathematical tools for immersed IGA

- Immersed IGA
 - Accurate and efficient integration
 - Multipatch coupling
 - Mesh adaptivity
 - Dynamics



**Adaptive IGA of
AM processes**
Carraturo et al. (2021)



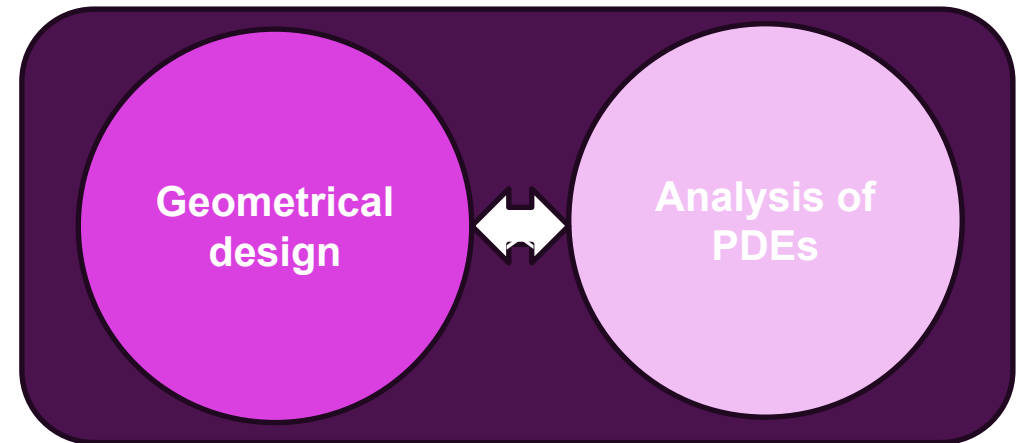
Literature review

Introduction to IGA



Utah teapot modeled using Bézier curves (Wikipedia)

- Isogeometric analysis (IGA) introduced in 2005
- Prior to IGA: CAD and FEM use **different descriptions** for the geometry
- Goal □ provide an end-to-end methodology



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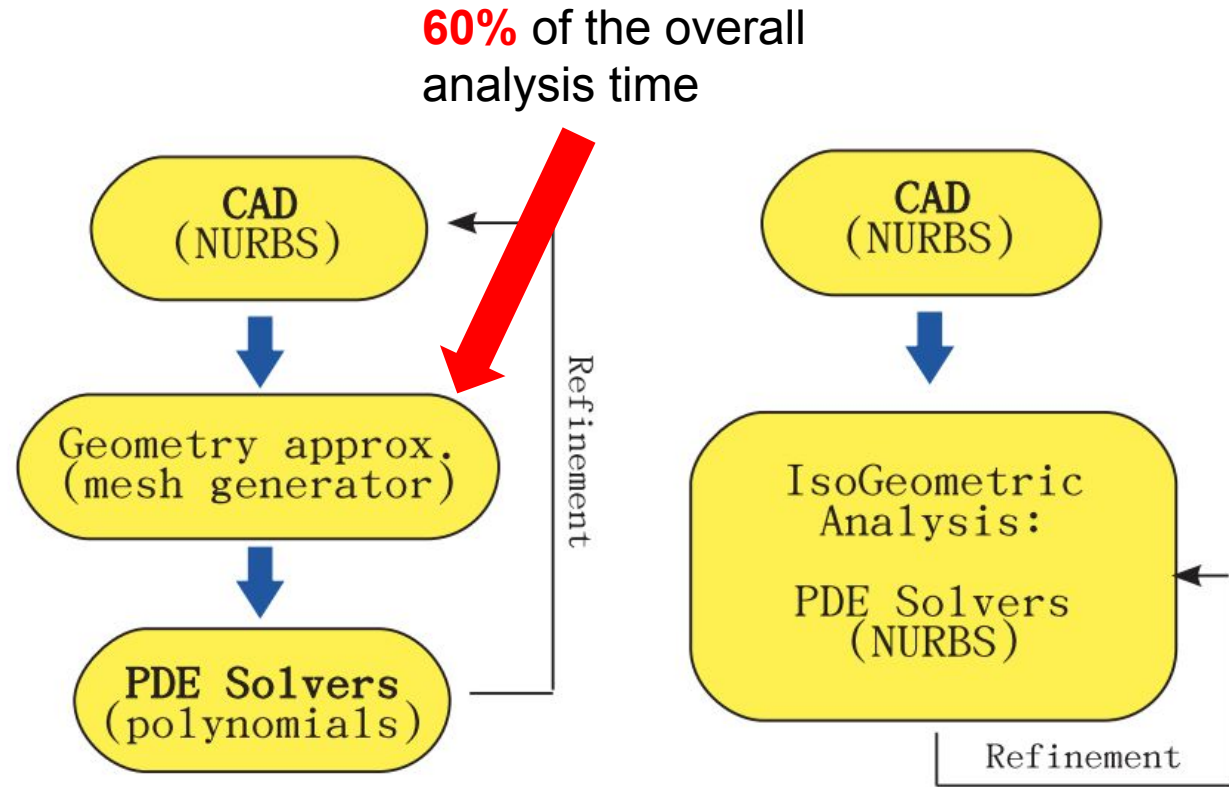
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Literature review

Introduction to IGA

- CAD and IGA **same geometry description**
 - Keep the geometric description given by CAD (NURBS)
 - Iso-parametric approach: PDEs are numerically solved with NURBS



Workflow: FEM vs. IGA

R. Vázquez et al. (2010)



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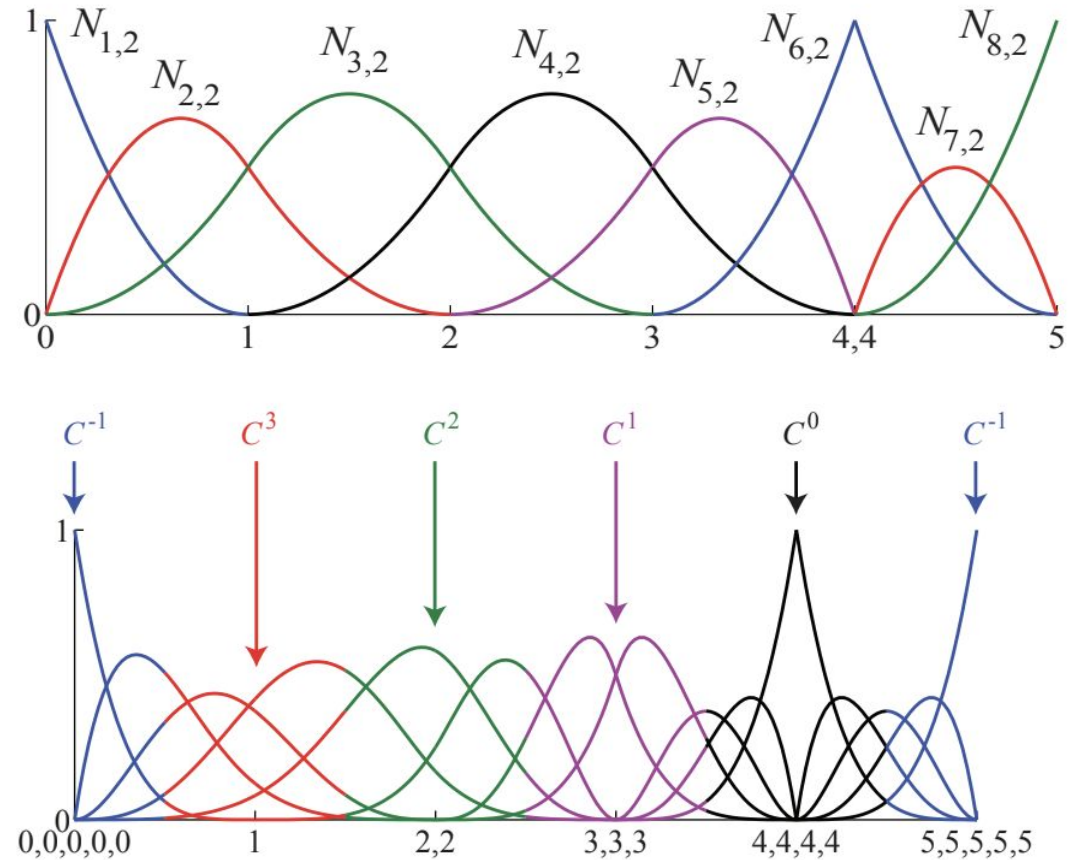
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Literature review

Covered topics

- B-splines for IGA
 - Properties
 - Control points and affine transformations
 - NURBS
- Refinement
- Domains with multiple patches



Quadratic (top) and quartic (bottom) basis functions

J. Austin Cottrell et al. (2009)



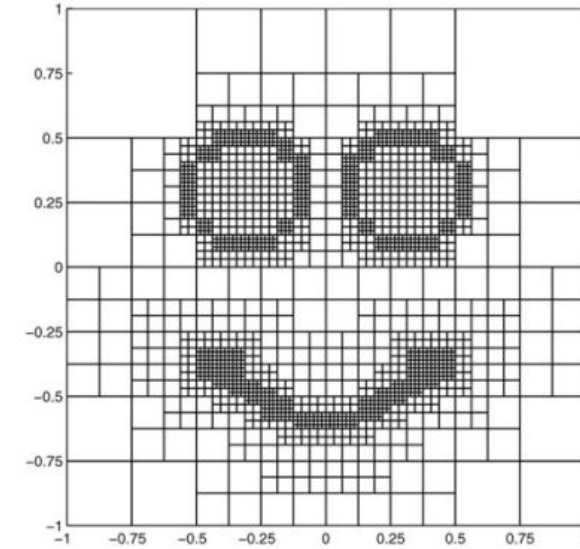
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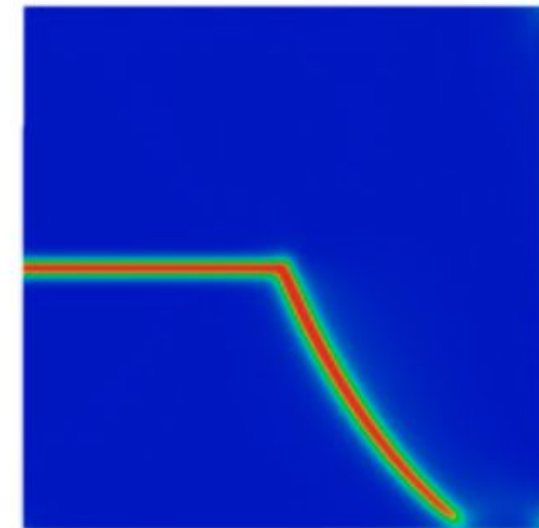


Next steps

- Literature review
 - Local refinement hierarchical splines
 - Phase-field models (IGA)
- Code framework
 - **NUTILS** (Python-based)
 - GeoPDEs (MATLAB-based)
 - Kratos course at CIMNE (Jan 29 - Feb 2)



Locally refined hierarchical mesh
C. Giannelli et al. (2012)



Crack phase field at completely fractured state with KL shell elements
J. Kiendl et al. (2016)





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Thank you!

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