MATRIX FREE WEIGHTED QUADRATURE FOR ULTRA-FAST ISOGEOMETRIC THERMAL MODELLING

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In recent decades, numerical methods applied to industrial problems have made great progress, so that today it is possible to reliably model different physical phenomena. However, numerical simulations often require many hours of computation or high-end tools to deal with complex problems. This is the case for thermomechanical process simulations, such as multi-pass welding which can require up to 60,000 CPU hours for really complex cases[1]. Nevertheless, the paradigm shift introduced by T. Hughes[2] through isogeometric analysis has made it possible to obtain a great improvement in the geometric modeling within analysis compared to standard finite element methods. This communication focuses on novel techniques like "weighted quadrature" and "matrix free" approaches which, coupled with isogeometric analysis, allow to:

- increase the polynomial degree of the shape functions to take advantage of the numerical stability of Bézier functions,
- reduce assembly time of global mass and stiffness matrices, cf.[3],
- reduce storage memory for matrix system resolution, cf.[4].

The objective of this communication is to illustrate the synergy between these different approaches, on simple linear thermal problems, to allow significant cost reductions.

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