Low-rank approximation for efficient isogeometric analysis

Angelos Mantzaflaris

Université Côte d'Azur, French national institute for computer science and applied mathematics (Inria)
Research center of Sophia Antipolis – Méditerranée, Project-team Aromath
2004 route des Lucioles, BP 93, 06902 Sophia Antipolis, France
e-mail: angelos.mantzaflaris@inria.fr, web page: http://www-sop.inria.fr

ABSTRACT

The spline discretisations employed in isogeometric analysis usually possess a global *tensor product structure*. The latter can be used in several steps of the simulation pipeline in order to reduce the overall computational complexity of isogeometric methods. The exploitation of this tensor product structure enables us to deal with the computational disadvantages stemming from the increased polynomial degrees and the larger support of the basis functions. In particular, *low-rank approximation techniques* can be applied in the parametric space, so that evaluation on large point sets, numerical integration, linear algebra operations, and so on, become computationally tractable for dimension higher than two. One key ingredient of the approach is a suitable projection of the pulled back differential operator to a lower-dimensional manifold of tensors, whose dimension is the *rank* of the tensor [1, 2, 3, 4]. Our benchmarks demonstrate that the use of tensor methods in isogeometric analysis possesses significant advantages. Both memory requirements and running times are drastically reduced, thus allowing for a massive scale up of the computations.

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