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EXPLOITING TCHEBYCHEFFIAN SPLINES IN ISOGEOMETRIC DISCRETIZATIONS

Krunal Raval*, Carla Manni and Hendrik Speleers

Department of Mathematics, University of Rome Tor Vergata
Via della Ricerca Scientifica 1, 00133 Rome, Italy
e-mail: [raval; manni; speleers]@mat.uniroma2.it

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Tchebycheffian splines are smooth piecewise functions with pieces in Tchebycheff spaces: the natural generalization of polynomials. Under suitable assumptions, Tchebycheffian splines admit special basis functions, called Tchebycheffian B-splines, possessing all fundamental properties of classical polynomial B-splines (minimal support, non-negativity, partition of unity, etc.) [1]. Thanks to these structural similarities, Tchebycheffian B-splines are plug-to-plug compatible with polynomial B-splines in several applications, ranging from geometric modeling to signal processing and numerical simulation. Their interest in applications has been recently strengthened by the efficient evaluation algorithm proposed in [2].

Tchebycheffian splines offer a huge flexibility compared to classical polynomial splines: they are equipped with parameters that can be selected according to a problem-oriented strategy, taking into account the geometrical and/or analytical issues of the specific addressed problem. This fine-tuning of spaces generally results in a gain from the accuracy point of view. A special instance of Tchebycheffian splines, called generalized polynomial splines, have been shown to be an interesting tool in isogeometric discretization methods [3–4], also offering the possibility of local refinement frameworks [5].

In this work we look beyond generalized polynomial splines and we discuss the use of Tchebycheffian splines as a possible tool in isogeometric discretizations.

REFERENCES

[1] T. Lyche, C. Manni, H. Speleers, Tchebycheffian B-splines revisited: an introductory exposition. In: C. Giannelli, H. Speleers (Eds.), *Advanced Methods for Geometric Modeling and Numerical Simulation*, Springer INdAM Series, Vol. **35**, pp. 179-216, 2019.

[2] R.R. Hiemstra, T.J.R. Hughes, C. Manni, H. Speleers, D. Toshniwal, A Tchebycheffian extension of multi-degree B-splines: algorithmic computation and properties. *SIAM J. Numer. Anal.*, Vol. **58**, pp. 1138-1163, 2020.

[3] C. Manni, F. Pelosi, M.L. Sampoli, Generalized B-splines as a tool in isogeometric analysis. *Comput. Methods Appl. Mech. Eng.*, Vol. **200**, pp. 867-881, 2011.

[4] C. Manni, F. Roman, H. Speleers, Generalized B-splines in isogeometric analysis. In: G.E. Fasshauer, L.L. Schumaker (Eds.), *Approximation Theory XV: San Antonio 2016*, Springer Proceedings in Mathematics & Statistics, Vol. **201**, pp. 239-267, 2017.

[5] C. Bracco, T. Lyche, C. Manni, F. Roman, H. Speleers, Generalized spline spaces over T-meshes: Dimension formula and locally refined generalized B-splines. *Appl. Math. Comput.*, Vol. **272**, pp. 187-198, 2016.