

# Space-Time Finite Element and Isogeometric Analysis of Parabolic Initial–Boundary Value Problems

*Ulrich Langer*

Institute of Computational Mathematics  
Johannes Kepler University, Altenberger Str. 69 3, A-4040 Linz, Austria

Johann Radon Institute for Computational and Applied Mathematics  
Austrian Academy of Sciences, Altenberger Str. 69, A-4040 Linz, Austria

Traditionally, parabolic and hyperbolic Initial-Boundary Value Problems (IBVP) are numerically solved by means of time-stepping methods together with some spatial discretization technique like the Finite Element Method (FEM) or the Isogeometric Analysis (IgA). To overcome the curse of sequentiality of time-stepping in connection with the use of massively parallel computers, we propose new, stable space-time methods that provide a possibly completely unstructured discretization of the space-time cylinder where the IBVP is posed. This approach allows us not only the parallelization of the corresponding solver in space and time simultaneously, but also space-time adaptivity and an easy treatment of moving interfaces and / or computational domains.

The talks is based on the joint research work of the author with his collaborators C. Hofer, M. Neumüller, S. Matculevich, S. Repin, A. Schafelner, I. Touloupoulos, and H. Yang, see also [1, 3, 2, 4].

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## References

- [1] C. Hofer, U. Langer, M. Neumüller, and I. Touloupoulos. Time-multipatch discontinuous Galerkin space-time isogeometric analysis of parabolic evolution problems. ETNA, 2018, accepted for publication.
- [2] U. Langer, S. Matculevich, and S. Repin. Guaranteed error control bounds for the stabilised space-time IgA approximations to parabolic problem. <https://arxiv.org/pdf/1712.06017.pdf>.
- [3] U. Langer, S. Moore, and M. Neumüller. Space-time isogeometric analysis of parabolic evolution equations. *Comput. Methods Appl. Mech. Engrg.*, 306:342–363, 2016.
- [4] U. Langer, and O. Steinbach (ed.). *Space-Time Methods: Application to Partial Differential Equations*. RSCAM, de Gruyter, Berlin 2019, in preparation.