

# DPG TIME-MARCHING SCHEME WITH DPG SEMIDISCRETIZATION IN SPACE FOR TRANSIENT ADVECTION-REACTION EQUATIONS

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## ABSTRACT

We present a general methodology [1] to combine a Discontinuous Petrov-Galerkin (DPG) semidiscretization in space together with the recently developed DPG-based time-marching scheme [2, 3, 4] for transient advection-reaction problems. Regarding the semidiscretization in space with DPG we redefine the ideas of optimal testing and practicality of the method in this context. As the DPG-based time-marching scheme is of exponential-type, we also discuss how to efficiently compute the action of the exponential over vectors of the matrix coming from the space semidiscretization without assembling the full matrix. Finally, we verify the proposed method for 1D+time advection-reaction problems showing optimal convergence rates both in space and time for smooth solutions and more stable results for linear conservation laws comparing to the classical exponential integrators. The method we propose is practical in the computational sense and it can easily be generalized to higher dimensions and to other problems.

## REFERENCES

- [1] J. Muñoz-Matute, L. Demkowicz, and N. V. Roberts, *Combining DPG in space with DPG time-marching scheme for the transient advection-reaction equation*, Computer Methods in Applied Mechanics and Engineering, In press, 2022.
- [2] J. Muñoz-Matute, L. Demkowicz, and D. Pardo, *Error representation of the time-marching DPG scheme*, Computer Methods in Applied Mechanics and Engineering, 391:114480, 2022.
- [3] J. Muñoz-Matute, D. Pardo, and L. Demkowicz, *A DPG-based time-marching scheme for linear hyperbolic problems*, Computer Methods in Applied Mechanics and Engineering, 373:113539, 2021.
- [4] J. Muñoz-Matute, D. Pardo, and L. Demkowicz, *Equivalence between the DPG method and the exponential integrators for linear parabolic problems*, Journal of Computational Physics, 429:110016, 2021.

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