List of Publications – Marlis Hochbruck – August 21, 2020

Recent preprints

[1] M. Hochbruck and J. Leibold. An implicit-explicit time discretization scheme for second-order semilinear wave equations with application to dynamic boundary conditions. CRC 1173 Preprint 2020/20, Karlsruhe Institute of Technology, July 2020. URL https://www.waves.kit.edu/downloads/CRC1173_Preprint_2020-20.pdf.

[2] S. Buchholz, B. Dörich, and M. Hochbruck. On averaged exponential integrators for semilinear wave equations with solutions of low-regularity. CRC 1173-Preprint 2020/8, Karlsruhe Institute of Technology, 2020. URL https://www.waves.kit.edu/downloads/CRC1173_Preprint_2020-8.pdf.

[3] M. Hochbruck and J. Köhler. Error analysis of discontinuous Galerkin discretizations of a class of linear wave-type problems. CRC 1173-Preprint 2019/14, Karlsruhe Institute of Technology, 2019. URL http://www.waves.kit.edu/downloads/CRC1173_Preprint_2019-14.pdf.

Peer reviewed papers

[1] C. Carle, M. Hochbruck, and A. Sturm. On leap-frog-Chebyshev schemes. *SIAM J. Numer. Anal.*, 58(4):2404–2433, 2020. URL https://doi.org/10.1137/18M1209453.

[2] M. Hochbruck and J. Leibold. Finite element discretization of semilinear acoustic wave equations with kinetic boundary conditions. *Electron. Trans. Numer. Anal.*, 53: 522–540, 2020. URL https://doi.org/10.1553/etna_vol53s522.

[3] M. Hochbruck, J. Leibold, and A. Ostermann. On the convergence of Lawson methods for semilinear stiff problems. *Numer. Math.*, 145:553–580, 2020. URL https://doi.org/10.1007/s00211-020-01120-4.

[4] M. Hochbruck, B. Maier, and C. Stohrer. Heterogeneous multiscale method for Maxwell's equations. *Multiscale Model. Sim.*, 17(4):1147–1171, 2019. URL https://doi.org/10.1137/18M1234072.

[5] M. M. Müller, B. Maier, C. Rockstuhl, and M. Hochbruck. Analytical and numerical analysis of linear and nonlinear properties of an rf-SQUID based metasurface. *Phys. Rev. B*, 99:075401, 2019. URL https://link.aps.org/doi/10.1103/PhysRevB.99.075401.

[6] M. Hochbruck and A. Sturm. Upwind discontinuous Galerkin space discretization and locally implicit time integration for linear Maxwell's equations. *Math. Comp.*, 88 (317):1121–1153, 2019. URL https://doi.org/10.1090/mcom/3365.

[7] M. Hochbruck and J. Köhler. On the efficiency of the Peaceman–Rachford ADI-dG method for wave-type problems. In F. Radu, K. Kumar, I. Berre, J. Nordbotten, and I. Pop, editors, *Numerical Mathematics and Advanced Applications ENUMATH 2017*,

volume 126 of *Lecture Notes in Computational Science and Engineering*, pages 135–144. Springer International Publishing, 2019. URL https://www.springer.com/de/book/9783319964140.

[8] D. Hipp, M. Hochbruck, and C. Stohrer. Unified error analysis for nonconforming space discretizations of wave-type equations. *IMA J. Numer. Anal.*, 39(3):1206–1245, 2019. URL https://doi.org/10.1093/imanum/dry036.

[9] M. Hochbruck, T. Pažur, and R. Schnaubelt. Error analysis of implicit Runge–Kutta methods for quasilinear hyperbolic evolution equations. *Numer. Math.*, 138(3):557–579, 2018. URL http://link.springer.com/article/10.1007/s00211-017-0914-6.

[10] S. Buchholz, L. Gauckler, V. Grimm, M. Hochbruck, and T. Jahnke. Closing the gap between trigonometric integrators and splitting methods for highly oscillatory differential equations. *IMA J. Numer. Anal.*, 38(1):57–74, 2018. URL https://doi.org/10.1093/imanum/drx007.

[11] M. Hochbruck and C. Stohrer. Finite element heterogeneous multiscale method for time-dependent Maxwell's equations. In M. L. Bittencourt, N. A. Dumont, and J. S. Hesthaven, editors, *Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2016*, pages 269–281, Cham, 2017. Springer International Publishing. URL https://doi.org/10.1007/978-3-319-65870-4_18.

[12] M. Hochbruck and T. Pažur. Error analysis of implicit Euler methods for quasilinear hyperbolic evolution equations. *Numer. Math.*, 135(2):547–569, 2017. URL http://dx.doi.org/10.1007/s00211-016-0810-5.

[13] L. Fath, M. Hochbruck, and C. Singh. A fast mollified impulse method for biomolecular atomistic simulations. *J. Comp. Phys.*, 333:180–198, 2017. URL http://dx.doi.org/10.1016/j.jcp.2016.12.024.

[14] M. Hochbruck and A. Sturm. Error analysis of a second-order locally implicit method for linear Maxwell's equations. *SIAM J. Numer. Anal.*, 54(5):3167–3191, 2016. URL http://dx.doi.org/10.1137/15M1038037.

[15] J. Deppler, B. Braun, A. Fidlin, and M. Hochbruck. Convergence of viscoelastic constraints to nonholonomic idealization. *European Journal of Mechanics - A/Solids*, 58:140–147, 2016. URL http://dx.doi.org/10.1016/j.euromechsol.2016.01.003.

[16] M. Hochbruck and T. Pažur. Implicit Runge–Kutta methods and discontinuous Galerkin discretizations for linear Maxwell's equations. *SIAM J. Numer. Anal.*, 53(1):485–507, 2015. URL http://dx.doi.org/10.1137/130944114.

[17] A. Demirel, J. Niegemann, K. Busch, and M. Hochbruck. Efficient multiple time-stepping algorithms of higher order. *J. Comp. Phys.*, 285:133–148, 2015. URL http://dx.doi.org/10.1016/j.jcp.2015.01.018.

[18] M. Hochbruck, T. Pažur, A. Schulz, E. Thawinan, and C. Wieners. Efficient time integration for discontinuous Galerkin approximations of linear wave equations. *ZAMM*, 95(3):237–259, 2015. URL http://dx.doi.org/10.1002/zamm.201300306.

[19] M. Hochbruck, T. Jahnke, and R. Schnaubelt. Convergence of an ADI splitting for Maxwell's equations. *Numer. Math.*, 129(3):535–561, 2015. URL https://doi.org/10.1007/s00211-014-0642-0.

[20] D. Hipp, M. Hochbruck, and A. Ostermann. An exponential integrator for non-autonomous parabolic problems. *ETNA*, 41:497–511, 2014. URL http://etna.mcs.kent.edu/volumes/2011-2020/vol41/abstract.php?vol=41&pages=497-511.

[21] M. A. Botchev, V. Grimm, and M. Hochbruck. Residual, restarting, and Richardson iteration for the matrix exponential. *SIAM J. Sci. Comput.*, 35(3):A1376–A1397, 2013. URL http://dx.doi.org/10.1137/110820191.

[22] M. Hochbruck and A. Ostermann. Exponential multistep methods of Adams-type. *BIT*, 51(4):889–908, 2011. URL http://dx.doi.org/10.1007/s10543-011-0332-6.

[23] T. Tückmantel, A. Pukhov, J. Liljo, and M. Hochbruck. Three-dimensional relativistic particle-in-cell hybrid code based on an exponential integrator. *IEEE Trans. Plasma Sci.*, 38(9):2383–2389, 2010. URL http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=05535138.

[24] M. Hochbruck and D. Löchel. A multilevel Jacobi-Davidson method for polynomial PDE eigenvalue problems arising in plasma physics. *SIAM J. Sci. Comput.*, 32(6):3151–3169, 2010. URL http://dx.doi.org/10.1137/090774604.

[25] M. Hochbruck and A. Ostermann. Exponential integrators. *Acta Numer.*, 19:209–286, 2010. URL http://dx.doi.org/10.1017/S0962492910000048.

[26] M. Hochbruck and M. Hönig. On the convergence of a regularizing Levenberg-Marquardt scheme for nonlinear ill-posed problems. *Numer. Math.*, 115(1):71–79, 2010. URL http://dx.doi.org/10.1007/s00211-009-0268-9.

[27] M. Hochbruck, M. Hönig, and A. Ostermann. A convergence analysis of the exponential Euler iteration for nonlinear ill-posed problems. *Inverse Problems*, 25(7):075009, 18, 2009. URL http://dx.doi.org/10.1088/0266-5611/25/7/075009.

[28] D. Löchel, M. Z. Tokar, M. Hochbruck, and D. Reiser. Effect of poloidal inhomogeneity in plasma parameters on edge anomalous transport. *Phys. Plasmas*, 16(4):044508, 2009. URL http://dx.doi.org/10.1063/1.3121222.

[29] M. Hochbruck, M. Hönig, and A. Ostermann. Regularization of nonlinear ill-posed problems by exponential integrators. *M2AN Math. Model. Numer. Anal.*, 43(4):709–720, 2009. URL http://dx.doi.org/10.1051/m2an/2009021.

[30] M. Hochbruck, A. Ostermann, and J. Schweitzer. Exponential Rosenbrock-type methods. *SIAM J. Numer. Anal.*, 47(1):786–803, 2008/09. URL http://dx.doi.org/10.1137/080717717.

[31] V. Grimm and M. Hochbruck. Rational approximation to trigonometric operators. *BIT*, 48(2):215–229, 2008. URL http://dx.doi.org/10.1007/s10543-008-0185-9.

[32] M. Hochbruck and J. Niehoff. Approximation of matrix operators applied to multiple vectors. *Math. Comput. Simulation*, 79(4):1270–1283, 2008. URL http://dx.doi.org/10.1016/j.matcom.2008.03.016.

[33] J. Liljo, A. Karmakar, A. Pukhov, and M. Hochbruck. One-dimensional electromagnetic relativistic PIC-hydrodynamic hybrid simulation code H-VLPL (hybrid virtual laser plasma lab). *Comput. Phys. Comm.*, 179(6):371–379, 2008. URL http://dx.doi.org/10.1016/j.cpc.2008.03.008.

[34] C. Karle, J. Schweitzer, M. Hochbruck, and K.-H. Spatschek. A parallel implementation of a two-dimensional fluid laser-plasma integrator for stratified plasma-vacuum systems. *J. Comput. Phys.*, 227(16):7701–7719, 2008. URL http://dx.doi.org/10.1016/j.jcp.2008.04.024.

[35] C. Karle, J. Schweitzer, M. Hochbruck, E.-W. Laedke, and K.-H. Spatschek. Numerical solution of nonlinear wave equations in stratified dispersive media. *J. Comput. Phys.*, 216(1):138–152, 2006. URL http://dx.doi.org/10.1016/j.jcp.2005.11.024.

[36] V. Grimm and M. Hochbruck. Error analysis of exponential integrators for oscillatory second-order differential equations. *J. Phys. A*, 39(19):5495–5507, 2006. URL http://dx.doi.org/10.1088/0305-4470/39/19/S10.

[37] J. van den Eshof and M. Hochbruck. Preconditioning Lanczos approximations to the matrix exponential. *SIAM J. Sci. Comput.*, 27(4):1438–1457, 2006. URL http://dx.doi.org/10.1137/040605461.

[38] M. Hochbruck and A. Ostermann. Explicit exponential Runge-Kutta methods for semilinear parabolic problems. *SIAM J. Numer. Anal.*, 43(3):1069–1090, 2005. URL http://dx.doi.org/10.1137/040611434.

[39] M. Hochbruck and A. Ostermann. Exponential Runge-Kutta methods for parabolic problems. *Appl. Numer. Math.*, 53(2-4):323–339, 2005. URL http://dx.doi.org/10.1016/j.apnum.2004.08.005.

[40] M. Hochbruck and C. Lubich. On Magnus integrators for time-dependent Schrödinger equations. *SIAM J. Numer. Anal.*, 41(3):945–963, 2003. URL http://dx.doi.org/10.1137/S0036142902403875.

[41] M. Hochbruck and J.-M. Sautter. Mathematik fürs Leben am Beispiel der Computertomographie. *Math. Semesterber.*, 49(1):95–113, 2002. URL http://dx.doi.org/10.1007/s005910200042.

[42] M. Hochbruck and C. Lubich. Exponential integrators for quantum-classical molecular dynamics. *BIT*, 39(4):620–645, 1999. URL http://dx.doi.org/10.1023/A:1022335122807.

[43] M. Hochbruck and C. Lubich. A Gautschi-type method for oscillatory second-order differential equations. *Numer. Math.*, 83(3):403–426, 1999. URL http://dx.doi.org/10.1007/s002110050456.

[44] M. Hochbruck and C. Lubich. A bunch of time integrators for quantum/classical molecular dynamics. In *Computational molecular dynamics: challenges, methods, ideas (Berlin, 1997)*, volume 4 of *Lect. Notes Comput. Sci. Eng.*, pages 421–432. Springer, Berlin, 1999. URL http://dx.doi.org/10.1007/978-3-642-58360-5_24.

[45] M. Hochbruck. A numerical comparison of look-ahead Levinson and Schur algorithms for non-Hermitian Toeplitz systems. In *High performance algorithms for structured matrix problems*, volume 2 of *Adv. Theory Comput. Math.*, pages 127–148. Nova Sci. Publ., Commack, NY, 1998.

[46] M. Hochbruck. Further optimized look-ahead recurrences for adjacent rows in the Padé table and Toeplitz matrix factorizations. *J. Comput. Appl. Math.*, 86(1):219–236, 1997. URL http://dx.doi.org/10.1016/S0377-0427(97)00157-X. Special issue dedicated to William B. Gragg (Monterey, CA, 1996).

[47] M. Hochbruck, C. Lubich, and H. Selhofer. Exponential integrators for large systems of differential equations. *SIAM J. Sci. Comput.*, 19(5):1552–1574, 1998. URL http://dx.doi.org/10.1137/S1064827595295337.

[48] M. Hochbruck and C. Lubich. Error analysis of Krylov methods in a nutshell. *SIAM J. Sci. Comput.*, 19(2):695–701, 1998. URL http://dx.doi.org/10.1137/S1064827595290450.

[49] M. H. Gutknecht and M. Hochbruck. Optimized look-ahead recurrences for adjacent rows in the Padé table. *BIT*, 36(2):264–285, 1996. URL http://dx.doi.org/10.1007/BF01731983.

[50] M. Hochbruck and C. Lubich. On Krylov subspace approximations to the matrix exponential operator. *SIAM J. Numer. Anal.*, 34(5):1911–1925, 1997. URL http://dx.doi.org/10.1137/S0036142995280572.

[51] B. Fischer, M. Hanke, and M. Hochbruck. A note on conjugate-gradient type methods for indefinite and/or inconsistent linear systems. *Numer. Algorithms*, 11(1-4):181–187, 1996. URL http://dx.doi.org/10.1007/BF02142495. Orthogonal polynomials and numerical analysis (Luminy, 1994).

[52] M. H. Gutknecht and M. Hochbruck. Look-ahead Levinson- and Schur-type recurrences in the Padé table. *Electron. Trans. Numer. Anal.*, 2(Sept.):104–129, 1994. URL http://etna.mcs.kent.edu/volumes/1993-2000/vol2/abstract.php?vol=2&pages=104-129.

[53] M. H. Gutknecht and M. Hochbruck. The stability of inversion formulas for Toeplitz matrices. *Linear Algebra Appl.*, 223/224:307–324, 1995. URL http://dx.doi.org/10.1016/0024-3795(94)00218-3. Special issue honoring Miroslav Fiedler and Vlastimil Pták.

[54] M. Hanke and M. Hochbruck. A Chebyshev-like semi-iteration for inconsistent linear systems. *Electron. Trans. Numer. Anal.*, 1(Dec.):89–103, 1993. URL http://etna.mcs.kent.edu/volumes/1993-2000/vol1/abstract.php?vol=1&pages=89-103.

[55] M. H. Gutknecht and M. Hochbruck. Look-ahead Levinson and Schur algorithms for non-Hermitian Toeplitz systems. *Numer. Math.*, 70(2):181–227, 1995. URL http://dx.doi.org/10.1007/s002110050116.

[56] M. Hochbruck and G. Starke. Preconditioned Krylov subspace methods for Lyapunov matrix equations. *SIAM J. Matrix Anal. Appl.*, 16(1):156–171, 1995. URL http://dx.doi.org/10.1137/S0895479892239238.

[57] R. W. Freund and M. Hochbruck. Gauß quadratures associated with the Arnoldi process and the Lanczos algorithm. In *Linear Algebra for Large-Scale and Real-Time Applications*, volume 232 of *Nato Science Series E*, pages 337–380. Kluwer Academic Publishers, 1993. B. de Moor, G. H. Golub, and M. Moonen, eds.

[58] M. Hanke, M. Hochbruck, and W. Niethammer. Experiments with Krylov subspace methods on a massively parallel computer. In *Proceedings of ISNA '92—International Symposium on Numerical Analysis, Part II (Prague, 1992)*, volume 38, pages 440–451, 1993.

[59] R. W. Freund and M. Hochbruck. On the use of two QMR algorithms for solving singular systems and applications in Markov chain modeling. *Numer. Linear Algebra Appl.*, 1(4):403–420, 1994. URL http://dx.doi.org/10.1002/nla.1680010406.

[60] R. W. Freund and M. Hochbruck. A biconjugate gradient-type algorithm for the iterative solution of non-Hermitian linear systems on massively parallel architectures. In *Computational and Applied Mathematics, I (Dublin, 1991)*, pages 169–178. North-Holland, Amsterdam, 1992.

Theses

[1] M. Hochbruck. *The Padé Table and its Relation to Certain Numerical Algorithms*. Habilitation thesis, Universität Tübingen, 1996.

[2] M. Hochbruck. *Lanczos– und Krylov–Verfahren für nicht-Hermitesche lineare Systeme*. PhD thesis, Universität Karlsruhe (TH), 1992.

Miscellaneous

[1] M. Hochbruck and A. Sturm. On the error analysis of full discretizations of linear Maxwell's equations. *Oberwolfach Reports*, 14(1):888–891, 2017. URL http://dx.doi.org/10.4171/OWR/2017/15.

[2] S. Buchholz, L. Gauckler, V. Grimm, M. Hochbruck, and T. Jahnke. Two different approaches to highly oscillatory problems. *Oberwolfach Reports*, 13(1):887–889, 2016. URL http://dx.doi.org/10.4171/OWR/2016/18.

[3] M. Hochbruck. A short course on exponential integrators. In Z. Bai, W. Gao, and Y. Su, editors, *Matrix functions and matrix equations*, Z. Bai, W. Gao, and Y. Su, editors, volume 19 of *Ser. Contemp. Appl. Math. CAM*, pages 28–49. Higher Ed. Press, Beijing, 2015.

[4] D. Hipp and M. Hochbruck. A preconditioned Krylov method for an exponential integrator for non-autonomous parabolic systems. *Oberwolfach Reports*, 11(1):822–824, 2014. URL http://dx.doi.org/10.4171/OWR/2014/14.

[5] D. Hipp, M. Hochbruck, and A. Ostermann. Exponential integrators for parabolic problems with time dependent coefficients. *Oberwolfach Reports*, 9(4):3602–3606, 2012. URL http://dx.doi.org/10.4171/OWR/2012/60.

[6] M. Hochbruck. *Mit Mathematik zu verlässlichen Simulationen: Numerische Verfahren zur Lösung zeitabhängiger Probleme*, In *Facettenreiche Mathematik*, pages 191–214. Springer-Verlag, 2011, K. Wendland, and A. Werner, eds. URL http://www.springer.com/de/book/9783834814142.

[7] M. Hochbruck and A. Ostermann. Explicit integrators of Rosenbrock-type. *Oberwolfach Reports*, 3(2):1107–1110, 2006. URL http://dx.doi.org/10.4171/OWR/2006/14.

[8] M. Hochbruck, A. Frommer, and B. Lang. Special volume on applied linear algebra. *Electron. Trans. Numer. Anal.*, 29:vii, 2007. URL http://etna.mcs.kent.edu/vol.29.2007-2008/preface.pdf.

[9] *A biconjugate gradient type algorithm on massively parallel architectures*, Dublin, Ireland, 1991. Proceedings of the 13th IMACS World Congress on Computation and Applied Mathematics.