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Publications

Publications in refereed Journals and Proceedings.

- (1) A. Kriegl, M. Losik, P.W. Michor, A. Rainer, *Lifting smooth curves over invariants for representations of compact Lie groups, II*, J. Lie Theory **15** (2005), No. 1, 227–234, ESI Preprint 1459, arXiv:math.RT/0402222.
- (2) A. Kriegl, M. Losik, P.W. Michor, A. Rainer, *Lifting smooth curves over invariants for representations of compact Lie groups, III*, J. Lie Theory **16** (2006), No. 3, 579–600, ESI Preprint 1806, arXiv:math.RT/0504101.
- (3) S. Hochgerner, A. Rainer, *Singular Poisson reduction of cotangent bundles*, Rev. Mat. Complut. **19** (2006), No. 2, 431–466, ESI Preprint 1681, arXiv:math.SG/0508455.
- (4) M. Losik, A. Rainer, *Choosing roots of polynomials with symmetries smoothly*, Rev. Mat. Complut. **20** (2007), No. 2, 267–291, ESI Preprint 1792, arXiv:math.CA/0603660.
- (5) A. Kriegl, M. Losik, P.W. Michor, A. Rainer, *Lifting mappings over invariants of finite groups*, Acta Math. Univ. Comenianae **77** (2008), No. 1, 93–122, ESI Preprint 1415, arXiv:math.AG/0312030.
- (6) A. Rainer, *Orbit projections as fibrations*, Czechoslovak Math. J. **59** (2009), No. 2, 529–538, ESI Preprint 1854, arXiv:math.DG/0610513.
- (7) A. Rainer, *Orbit projections of proper Lie groupoids as fibrations*, Czechoslovak Math. J. **59** (2009), No. 3, 591–594, arXiv:0712.0706.
- (8) A. Rainer, *Invariant functions in Denjoy–Carleman classes*, Annals of Global Analysis and Geometry **35** (2009), No. 3, 249–266, <http://dx.doi.org/10.1007/s10455-008-9135-7>, arXiv:0711.3163.
- (9) A. Kriegl, P.W. Michor, A. Rainer, *The convenient setting for non-quasianalytic Denjoy–Carleman differentiable mappings*, Journal of Functional Analysis **256** (2009), 3510–3544. <http://dx.doi.org/10.1016/j.jfa.2009.03.003>, arXiv:0804.2995.
- (10) A. Rainer, *Perturbation of complex polynomials and normal operators*, Math. Nach. **282** (2009), No. 12, 1623–1636. <http://dx.doi.org/10.1002/mana.200910837>, arXiv:math.CA/0611633.
- (11) A. Rainer, *Smooth roots of hyperbolic polynomials with definable coefficients*, Israel J. Math., **184** (2011), No. 1, 157–182. <http://dx.doi.org/10.1007/s11856-011-0063-z>, arXiv:0904.4164.
- (12) A. Rainer, *Quasianalytic multiparameter perturbation of polynomials and normal matrices*, Trans. Amer. Math. Soc. **363** (2011), No. 9, 4945–4977. <http://dx.doi.org/10.1090/S0002-9947-2011-05311-0>. arXiv:0905.0837.
- (13) M. Losik, P.W. Michor, A. Rainer, *A generalization of Puiseux’s theorem and lifting curves over invariants*, Rev. Mat. Complut. **25** (2012), No. 1, 139–155. <http://dx.doi.org/10.1007/s13163-011-0062-y>, arXiv:0904.2068.
- (14) A. Rainer, *Lifting quasianalytic mappings over invariants*, Canad. J. Math. **64** (2012), No. 2, 409–428. <http://dx.doi.org/10.4153/CJM-2011-049-0>, arXiv:1007.0836.
- (15) A. Kriegl, P.W. Michor, A. Rainer, *The convenient setting for quasianalytic Denjoy–Carleman differentiable mappings*, Journal of Functional Analysis **261** (2011), 1799–1834. <http://dx.doi.org/10.1016/j.jfa.2011.05.019>, arXiv:0909.5632.
- (16) A. Kriegl, P.W. Michor, A. Rainer, *Many parameter Hölder perturbation of unbounded operators*, Math. Ann. **353** (2012), 519–522. <http://dx.doi.org/10.1007/s00208-011-0693-9>, arXiv:math.FA/0611506.
- (17) A. Kriegl, M. Losik, P.W. Michor, A. Rainer, *Addendum to: “Lifting smooth curves over invariants for representations of compact Lie groups, III” [J. Lie Theory **16** (2006), No. 3, 579–600.]*, J. Lie Theory **22** (2012), No. 1, 245–249. arXiv:1106.6041.

- (18) A. Kriegl, P.W. Michor, A. Rainer, *Denjoy–Carleman differentiable perturbation of polynomials and unbounded operators*, Integral Equations and Operator Theory **71** (2011), No. 3, 407–416. <http://dx.doi.org/10.1007/s00020-011-1900-5>, arXiv:0910.0155.
- (19) A. Rainer, *Perturbation theory for normal operators*, Trans. Amer. Math. Soc., **365** (2013), 5545–5577. <http://dx.doi.org/10.1090/S0002-9947-2013-05854-0>, arXiv:1111.4475.
- (20) A. Rainer, *Differentiable roots, eigenvalues, and eigenvectors*, Israel J. Math., **201** (2014), No. 1, 99–122. <http://dx.doi.org/10.1007/s11856-014-0007-5>, arXiv:1211.4124.
- (21) A. Rainer, G. Schindl, *Composition in ultradifferentiable classes*, Studia Math., **224** (2014), No. 2, 97–131. <http://dx.doi.org/10.4046/sm224-2-1>, arXiv:1210.5102.
- (22) A. Kriegl, P.W. Michor, A. Rainer, *An exotic zoo of diffeomorphism groups on \mathbb{R}^n* , Annals of Global Analysis and Geometry **47** (2015), No. 2, 179–222, <http://dx.doi.org/10.1007/s10455-014-9442-0>, arXiv:1404.7033.
- (23) A. Parusiński, A. Rainer, *A new proof of Bronshtein’s theorem*, J. Hyperbolic Differ. Equ., **12** (2015), No. 4, 671–688, <http://dx.doi.org/10.1142/S0219891615500198>, arXiv:1309.2150.
- (24) A. Kriegl, P.W. Michor, A. Rainer, *The convenient setting for Denjoy–Carleman differentiable mappings of Beurling and Roumieu type*, Rev. Mat. Complut., **28** (2015), No. 3, 549–597. <http://dx.doi.org/10.1007/s13163-014-0167-1>, arXiv:1111.1819.
- (25) A. Rainer, G. Schindl, *Equivalence of stability properties for ultradifferentiable function classes*, Rev. R. Acad. Cienc. Exactas Fis. Nat. Ser. A Math. RACSAM., **110** (2016), No. 1, 17–32. <http://dx.doi.org/10.1007/s13398-014-0216-0>, arXiv:1407.6673.
- (26) A. Parusiński, A. Rainer, *Regularity of roots of polynomials*, Ann. Sc. Norm. Super. Pisa Cl. Sci. (5), **16** (2016), 481–517. http://dx.doi.org/10.2422/2036-2145.201404_014, arXiv:1309.2151.
- (27) A. Parusiński, A. Rainer, *Lifting differentiable curves from orbit spaces*, Transformation Groups, **21** (2016), No. 1, 153–179. <http://dx.doi.org/10.1007/s00031-015-9346-5>, arXiv:1406.2485.
- (28) A. Kriegl, P.W. Michor, A. Rainer, *The exponential law for spaces of test functions and diffeomorphism groups*, Indag. Math. (N.S.), **27** (2016), 225–265. <http://dx.doi.org/10.1016/j.indag.2015.10.006>, arXiv:1411.0483.
- (29) A. Rainer, G. Schindl, *On the Borel mapping in the quasianalytic setting*, Math. Scand. **121** (2017), 293–310. <https://doi.org/10.7146/math.scand.a-97101>, arXiv:1509.05565.
- (30) A. Rainer, G. Schindl, *Extension of Whitney jets of controlled growth*, Math. Nachr. **290** (2017), no. 14–15, 2356–2374. <http://dx.doi.org/10.1002/mana.201600321>, arXiv:1607.01206.
- (31) A. Parusiński, A. Rainer, *Optimal Sobolev regularity of roots of polynomials*, Ann. Sci. Ec. Norm. Super. (4) **51** (2018), No. 5, 1343–1387, <http://dx.doi.org/10.24033/asens.2376>, arXiv:1506.01512.
- (32) D.N. Nenning, A. Rainer, *On groups of Hölder diffeomorphisms and their regularity*, Trans. Amer. Math. Soc. **370** (2018), No. 8, 5761–5794, <http://dx.doi.org/10.1090/tran/7269>, arXiv:1612.03390.
- (33) A. Rainer, *Recognizing (ultra)differentiable functions on closed sets*, Oberwolfach Reports Volume 14 (2017), Issue 2, 1369–1372. <http://dx.doi.org/10.4171/OWR/2017/22>.
- (34) A. Rainer, G. Schindl, *On the extension of Whitney ultrajets*, Studia Math. **245** (2019), No. 3, 255–287. <https://doi.org/10.4064/sm170906-23-11>, arXiv:1709.00932.
- (35) Piotr T. Chrząściciel, Erwann Delay, Paul Klinger, with an Appendix by Andreas Kriegl, Peter W. Michor, and Armin Rainer, *Non-singular spacetimes with a negative cosmological constant: V. Boson stars*, Lett. Math. Phys. **108** (2018), No. 9, 2009–2030. <https://doi.org/10.1007/s11005-018-1062-3>, arXiv:1708.02878.
- (36) M. Bruveris, P.W. Michor, A. Parusiński, A. Rainer, *Moser’s theorem on manifolds with corners*, Proc. Amer. Math. Soc. **146** (2018), no. 11, 4889–4897. <https://doi.org/10.1090/proc/14130>, arXiv:1604.07787.
- (37) D.N. Nenning, A. Rainer, *The Trouvé group for spaces of test functions*, Rev. R. Acad. Cienc. Exactas Fis. Nat. Ser. A Math. RACSAM **113** (2019), No. 3, 1799–1822. <https://doi.org/10.1007/s13398-018-0581-1>, arXiv:1711.01196.
- (38) A. Rainer, G. Schindl, *On the extension of Whitney ultrajets, II*, Studia Math. **250** (2020), No. 3, 283–295. <https://doi.org/10.4064/sm180903-12-11>, arXiv:1808.10253.
- (39) A. Rainer, *Arc-smooth functions on closed sets*, Compositio Mathematica **155** (2019), 645–680. <https://doi.org/10.1112/S0010437X19007097>, arXiv:1801.08335.

- (40) A. Rainer, *Quasianalytic ultradifferentiability cannot be tested in lower dimensions*, Bulletin of the Belgian Mathematical Society - Simon Stevin, **26** (2019), 505–517. <https://doi.org/10.36045/bbms/1576206353>, arXiv:1810.10767.
- (41) S. Fürdös, D.N. Nenning, A. Rainer, G. Schindl, *Almost analytic extensions of ultradifferentiable functions with applications to microlocal analysis*, Journal of Mathematical Analysis and Applications **481** (2020), No. 1, <https://doi.org/10.1016/j.jmaa.2019.123451>, arXiv:1904.07634.
- (42) A. Parusiński, A. Rainer, *Selections of bounded variation for roots of smooth polynomials*, Selecta Mathematica **26**, 13 (2020), <https://doi.org/10.1007/s00029-020-0538-z>, arXiv:1705.10492.
- (43) A. Rainer, *Ultradifferentiable Chevalley theorems and isotropic functions*, Annali di Matematica Pura ed Applicata **200** (2021), No. 2, 491-504, <https://doi.org/10.1007/s10231-020-01003-3>, arXiv:1912.09114.
- (44) A. Rainer, *On the extension of Whitney ultrajets of Beurling type*, Results in Mathematics **76**, 36 (2021), <https://doi.org/10.1007/s00025-021-01347-z>, arXiv:2011.02178.
- (45) A. Parusiński, A. Rainer, *Sobolev lifting over invariants*, SIGMA Symmetry, Integrability and Geometry: Methods and Applications **17** (2021), 037, 31 pages, <https://doi.org/10.3842/SIGMA.2021.037>, arXiv:2003.01967.
- (46) A. Rainer, *Roots of Gårding hyperbolic polynomials*, Proc. Amer. Math. Soc., **150** (2022), No. 6, 2433-2446. <https://doi.org/10.1090/proc/15634>, arXiv:2012.01077.
- (47) D.N. Nenning, A. Rainer, G. Schindl, *Ultraholomorphic sectorial extensions of Beurling type*, Annals of Functional Analysis **12**, 45 (2021). <https://doi.org/10.1007/s43034-021-00124-x>, arXiv:2012.12332.
- (48) D.N. Nenning, A. Rainer, G. Schindl, *Nonlinear conditions for ultradifferentiability*, J. Geom. Anal. **31**, 12264-12287 (2021). <https://doi.org/10.1007/s12220-021-00718-w>, arXiv:2102.03871.
- (49) A. Rainer, *Ultradifferentiable extension theorems: a survey*, Expositiones Mathematicae **40** (2022), No. 3, 679-757. <https://doi.org/10.1016/j.exmath.2021.12.001>, arXiv:2107.01061.
- (50) D.N. Nenning, A. Rainer, G. Schindl, *Nonlinear conditions for ultradifferentiability: a uniform approach*, J. Geom. Anal. **32**, 171 (2022). <https://doi.org/10.1007/s12220-022-00914-2>, arXiv:2109.07795.
- (51) A. Rainer, *Hölder-Zygmund classes on smooth curves*, Z. Anal. Anwend., 41, no. 1 (2022), 189-209. <https://doi.org/10.4171/zaa/1704>, arXiv:2203.04191.
- (52) D.N. Nenning, A. Rainer, G. Schindl, *On optimal solutions of the Borel problem in the Roumieu case*, Bull. Belg. Math. Soc. Simon Stevin **29** (2022), no. 4, 509-531. <https://doi.org/10.36045/j.bbms.220322>, arXiv:2112.08463.
- (53) D.N. Nenning, A. Rainer, G. Schindl, *The Borel map in the mixed Beurling setting*, Rev. R. Acad. Cienc. Exactas Fis. Nat. Ser. A Math. RACSAM **117** (2023), Article number 40, <https://doi.org/10.1007/s13398-022-01372-9>, arXiv:2205.08195.
- (54) A. Rainer, *Arc-smooth functions and cuspidality of sets*, accepted for publication in Journal d'Analyse Mathématique. arXiv:2112.14163.
- (55) A. Rainer, *Quantitative tame properties of differentiable functions with controlled derivatives*, Nonlinear Analysis **237** (2023), 113372, <https://doi.org/10.1016/j.na.2023.113372>, arXiv:2208.04006.
- (56) A. Parusiński and A. Rainer, *Definable Lipschitz selections for affine-set valued maps*, accepted for publication in Israel Journal of Mathematics. arXiv:2306.09155.
- (57) A. Rainer, *On real analytic functions on closed subanalytic domains*, Archiv der Mathematik (2024), <https://doi.org/10.1007/s00013-024-01983-1>, arXiv:2311.03014.

Preprints and Work in Progress.

- A. Parusiński and A. Rainer, *Uniform extension of definable $C^{m,\omega}$ -Whitney jets*, arXiv:2306.09156.
- A. Parusiński and A. Rainer, *Perturbation theory of polynomials and linear operators*, arXiv:2308.01299.
- A. Rainer and G. Schindl, *Interpolation of derivatives and ultradifferentiable regularity* arXiv:2312.07020.

Research Monograph. *Perturbation of hyperbolic polynomials and related lifting problems*, enlarged and corrected version of the doctoral thesis as monograph, in preparation,
<http://www.mat.univie.ac.at/~armin/publ/roots-lifts.pdf>

Habilitation Thesis. *Perturbation theory for polynomials and linear operators & The convenient setting for Denjoy–Carleman differentiable mappings*,
<http://www.mat.univie.ac.at/~armin/publ/habilitation.pdf>

Doctoral Thesis. *Choosing roots of polynomials smoothly and lifting smooth curves over invariants*,
<http://www.mat.univie.ac.at/~armin/publ/dissertation.pdf>

Diploma Thesis. *Zerlegungsgleichheit von Kreis und Quadrat*, in German,
<http://www.mat.univie.ac.at/~armin/publ/diplom.pdf>