Dr. Felix Voigtlaender

Ph.D. in Mathematics

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Personal information

Age 29 (Born: 4. November 1988)
Nationality German

Education

2013–2015 **PhD student**, RWTH Aachen University
PhD thesis: "Embedding Theorems for Decomposition Spaces with Applications to Wavelet Coorbit Spaces"
Supervisor: Prof. Dr. Hartmut Führ
Contents:
- Interpretation of wavelet-type coorbit spaces as decomp. spaces (generalization of Modulation/Besov spaces)
- Development of a general theory of embeddings for decomposition spaces

Thesis handed in 5. May 2015; thesis defense: 3. November 2015
Grade: Summa cum laude

2010–2013 **Master student in Mathematics**, RWTH Aachen University
Overall grade: Excellent (1.0)
Thesis: "Spektralkalkül auf Gruppen von polynomialem Wachstum" ("Spectral calculus on groups of pol. growth")

2007–2012 **Bachelor student in Computer Science**, RWTH Aachen University
Overall grade: Excellent (1.1)
Thesis: "Advanced Trace-Based Analysis of Hybrid Programs"

2007–2010 **Bachelor student in Mathematics**, RWTH Aachen University
Overall grade: Excellent (1.0)
Thesis: "Integraldarstellung metaplektischer Operatoren" ("Integral representation of metaplectic operators")

2007 **High school Diploma**
Average grade: 1.5 (on a scale of 1 (best) to 5 (worst))
Intensive courses: Mathematics and Physics

Employment History

Since Feb. 2018 **Research assistant**, KU Eichstätt-Ingolstadt, Department of Scientific Computing
Supervisor: Prof. Dr. Götz Pfander

Apr. 2016–Jan. 2018 **Research assistant**, TU Berlin, Applied Harmonic Analysis Group
Supervisor: Prof. Dr. Gitta Kutyniok

2013–2016 **Research assistant**, RWTH Aachen University, Lehrstuhl A für Mathematik
Supervisor: Prof. Dr. Hartmut Führ

2009–2013 **Student teaching assistant**, RWTH Aachen University, Lehrstuhl A für Mathematik

Prizes, Awards and Scholarships

2016 **Friedrich Willhelm Award 2016**
For the best PhD thesis in mathematics at RWTH in the academic year 2015/2016

2016 **Teaching award of the student council of mathematics at RWTH Aachen University**
For the best teaching assistant in mathematics in the academic year 2014/2015

2014 **Friedrich Willhelm Award 2014**
For the best master thesis in mathematics at RWTH in the academic year 2013/2014

2014 **Springorum Medal 2014**
For completing the masters degree with distinction

2011–2013 **Stipend of the education fund of the RWTH Aachen University ("Deutschlandstipendium")**
Funding provided by
- 2011–2012: Ericsson GmbH – Eurolab
- 2012–2013: Dr. Franz Wirtz/proRWTH

2012 **Schöneborn Award 2012**
For outstanding performance in the Bachelors program in computer science

2011 **Schöneborn Award 2011**
For outstanding performance in the Bachelors program in mathematics

2009–2013 **Mentioning on the "Dean's List" containing the top 5% of best students at RWTH Aachen**

2009 **Selected for participation in the RWTH International Research Opportunity Program (IROP)**
Two month stay (June – August) at the Massachusetts Institute of Technology (MIT), Boston.
Participation in the working group "New Media Medicine" at the MIT Media Lab

Experience in Teaching

2018 **Teaching Assistant**, KU Eichstätt-Ingolstadt, Summersemester 2018
Ordinary differential equations

2016–2017 **Instructor**, TU Berlin, Wintersemester 2016/2017
Seminar "Applied Functional Analysis"

2013–2016 **Teaching assistant**, RWTH Aachen University, Lehrstuhl A für Mathematik
- 2013/2014: Analysis I
- 2014/2015: Analysis III
- 2015: Harmonic Analysis II
- 2015/2016: Analysis I

2008–2013 **Student teaching assistant**, RWTH Aachen University, Lehrstuhl A für Mathematik
- 2008/2009: Analysis for computer scientists
- 2009/2010: Analysis I
- 2010: Analysis II
- 2010/2011: Analysis III
- 2011: Ordinary differential equations
- 2011/2012: Topology
- 2012/2013: Functional analysis

Publications

Journal Articles

1 P. Petersen and F. Voigtlaender. Optimal approximation of piecewise smooth functions using deep ReLU neural networks. *accepted for publication in Neural Netw.*, 2018. `arxiv.org/abs/1709.05289`.

2 J. Fell, H. Führ, and F. Voigtlaender. Resolution of the Wavefront Set Using General Continuous Wavelet Transforms. *J. Fourier Anal. Appl.*, 22(5):997–1058, Oct 2016.

3 H. G. Feichtinger and F. Voigtlaender. From Frazier-Jawerth characterizations of Besov spaces to Wavelets and Decomposition spaces. *Contemp. Math., 693*, 2016.

4 D. Böhme, M. Geimer, L. Arnold, F. Voigtlaender, and F. Wolf. Identifying the root causes of wait states in large-scale parallel applications. *ACM Trans. Parallel Comput.*, 3(2):11:1–11:24, July 2016.

5 H. Führ and F. Voigtlaender. Wavelet coorbit spaces viewed as decomposition spaces. *J. Funct. Anal.*, 269(1):80–154, 2015.

Conference Proceedings

1 J. Fell, H. Führ, and F. Voigtlaender. Resolution of the wave front set using general wavelet transforms. In *International Conference on Sampling Theory and Applications (SampTA) 2015*, pages 332–336, May 2015.

2 F. Voigtlaender. Understanding X-let sparsity via decomposition spaces. In *International Conference on Sampling Theory and Applications (SampTA) 2017*, pages 523–527, July 2017.

Preprints

1 P. Petersen, M. Raslan, and F. Voigtlaender. Topological properties of the set of functions generated by neural networks of fixed size. *arXiv preprints*, 2018. `arxiv.org/abs/1806.08459`.

2 S. Dahlke, F. De Mari, E. De Vito, L. Sawatzki, G. Steidl, G. Teschke, and F. Voigtlaender. On the Atomic Decomposition of Coorbit Spaces with Non-Integrable Kernel. *arXiv preprints*, 2018. `arxiv.org/abs/1807.06380`.

3 F. Voigtlaender. A general version of Price's theorem. *arXiv preprints*, 2017. `arxiv.org/abs/1710.03576`.

4 F. Voigtlaender and A. Pein. Analysis sparsity vs. synthesis sparsity for α-shearlets. *arXiv preprints*, 2017. `arxiv.org/abs/1702.03559v1`.

5 F. Voigtlaender. Structured, Compactly Supported Banach Frame Decompositions of Decomposition Spaces. *arXiv preprints*, 2016. `arxiv.org/abs/1612.08772`.

6 F. Voigtlaender. Embeddings of decomposition spaces. *arXiv preprints*, 2016. `arxiv.org/abs/1605.09705`.

7 F. Voigtlaender. Embeddings of Decomposition Spaces into Sobolev and BV Spaces. *arXiv preprints*, 2016. `arxiv.org/abs/1601.02201`.

Invited Talks, Posters and Lectures

2018 **Conference IWOTA 2018 (International Workshop on Operator Theory and Applications)**, *East China Normal University, Shanghai, China*, 23. July 2018
Talk title: "Analyzing sparsity properties of frames using decomposition spaces"

2018 **Workshop Donau-Isar-Inn (WDI² – Approximation Theory and Applications)**, *TU München, Munich, Germany*, 20. July 2018
Talk title: "Approximation theoretic properties of deep ReLU neural networks"

2018 **Oberwolfach Workshop "Applied Harmonic Analysis and Data Processing"**, *Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany*, 28. February 2018
Talk title: "Approximation Properties of Deep ReLU Networks"

2018 **ARI Guest-Talk**, *Acoustic Research Institute, Vienna, Austria*, 21. February 2018
Talk title: "Describing sparsity properties of frames using function spaces"

2017 **Graduate Seminar "Advanced Topics in PDE and Harmonic Analysis"**, *Universität Bonn, Bonn, Germany*, 24. November 2017
Talk title: "Understanding sparsity properties of frames using decomposition spaces"

2017 **Research Seminar "Mathematics of Computation"**, *Universität Bonn, Bonn, Germany*, 23. November 2017
Talk title: "Optimal approximation of piecewise smooth functions using deep ReLU neural networks"

2017 **Zurich Colloquium in Applied and Computational Mathematics**, *ETH Zürich, Zürich, Switzerland*, 15. November 2017
Talk title: "Optimal approximation of piecewise smooth functions using deep ReLU neural networks"

2017 **Summer School on Applied Harmonic Analysis**, *Genoa, Italy*, 24.–28. July 2017
Lecture series title: "Sparsity Properties of Frames via Decomposition Spaces"

2016 **Conference: Coherent States and their Applications: A Contemporary Panorama**, *Marseille, CIRM, France*, 15. November 2016
Talk title: "Shearlets: Theory, applications and generalizations"

2014 **Seminar talk at the Lehrstuhl für Analysis, University of Jena**, *Jena, Germany*, 12. November 2014
Talk title: "Embeddings between decomposition spaces"

Refereeing work

Referee For the following journals:
- *Journal of Functional Analysis*, Elsevier
- *Mathematische Nachrichten*, Wiley
- *Monatshefte für Mathematik*, Springer
- *Journal of Fourier Analysis and Applications*, Springer (Birkhäuser)
- *International Journal of Wavelets, Multiresolution and Information Processing*, World Scientific
- *Journal of Nonlinear Science and Applications*, International Scientific Research Publications
- *Science China. Mathematics*, Springer
- *Mediterranean Journal of Mathematics*, Springer

Research visits

2018

Research visit with Dr. Nicki Holighaus, *Acoustic Research Institute, Vienna, Austria*, 19.–23. February 2018
Main topic: “Warped time frequency systems in higher dimensions”

2017

Research visit with Dr. Rima Alaifari, *ETH Zürich, Zürich, Switzerland*, 13.–17. November 2017
Main topic: “Phase retrieval from Gabor coefficients”

2014

Research visit with Professor H.G. Feichtinger, *Marseille, CIRM, 4.–10. October 2014*
Main topic: “Embeddings for decomposition spaces”