

# Dr. Philipp Christian Petersen

## Curriculum Vitae

Technische Universität Berlin  
Institut für Mathematik  
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### Education

- 06/2016 **Ph.D.**, *Technische Universität Berlin.*
- 03/2013 **Master of Science in Mathematik**, *Technische Universität Berlin.*
- 03/2011 **Bachelor of Science in Mathematik**, *Technische Universität Berlin.*
- 06/2006 **Abitur**, *Humboldt Gymnasium Tegel, Berlin.*

### Employment History

- 07/2018 - 06/2019 **Researcher**, *University of Oxford, Mathematical Institute.*
- 04/2013–06/2018 **Researcher**, *Technische Universität Berlin, SFB/TRR 109 "Discretization in Geometry and Dynamics".*
- 06/2012–04/2013 **Student assistant**, *Technische Universität Berlin, Applied Functional Analysis Group.*
- 06/2011–06/2012 **Student assistant**, *Landesbank Berlin - LBB, Pricing and Modeling.*

### Teaching

- WS16/17 **Functional analysis 2**, *Lecturer.*
- WS16/17 **Seminar Applied Functional Analysis**, *Instructor.*
- SS14 **Funktional analysis 3**, *Assistant.*

### Awards

- 2017 BiMoS PhD Award
- 2017 Dr. Klaus Körper Preis of the GAMM
- 2014 GAMM Junior 2014.

### Publications

#### Articles

- [1] **C. Lessig, P. Petersen, and M. Schäfer**, *Bendlets: A Second-Order Shearlet Transform with Bent Elements*, *Appl. Comput. Harmon. Anal.*, in Press.
- [2] **G. Kutyniok, V. Mehrmann, and P. Petersen**, *Regularization and Numerical Solution of the Inverse Scattering Problem using Shearlet Frames*, *J. Inverse Ill-Posed Probl.*, 25(3), 287–309, 2017. .

- [3] **G. Kutyniok and P. Petersen**, *Classification of edges using compactly supported shearlets*, Appl. Comput. Harmon. Anal., 42(2), 245–293, 2017.
- [4] **P. Petersen**, *Shearlet approximation of functions with discontinuous derivatives*, J. Approx. Theory, 207, 127–138, 2016.
- [5] **J. Ma and P. Petersen**, *Linear independence of compactly supported separable shearlet systems*, J. Math. Anal. Appl., 428 (1), 238–257, 2015.

#### Conference Proceedings

- [1] **H. Bölcskei, P. Grohs, G. Kutyniok, and P. Petersen**, *Memory-optimal neural network approximation*, Proc. of SPIE (Wavelets and Sparsity XVII), San Diego, USA, 2017, to appear.

#### Preprints

- [1] **P. Grohs, G. Kutyniok, J. Ma, and P. Petersen**, *Anisotropic multiscale systems on bounded domains*, arXiv:1510.04538v1, 2015.
- [2] **H. Bölcskei, P. Grohs, G. Kutyniok, and P. Petersen**, *Optimally Sparse Approximation with Deep Neural Networks*, arXiv:1705.01714, 2017.
- [3] **P. Petersen, F. Voigtlaender**, *Optimal approximation of piecewise smooth functions using deep ReLU neural networks*, arXiv:1709.05289, 2017.
- [4] **P. Petersen, M. Raslan,**, *Approximation properties of shearlet frames for Sobolev Spaces*, arXiv:1712.01047, 2017.
- [5] **P. Petersen, M. Raslan, F. Voigtlaender**, *Topological properties of the set of functions generated by neural networks of fixed size*, arXiv:1806.08459, 2018.

#### Monographs

- [1] **P. Petersen**, *Shearlets on Bounded Domains and Analysis of Singularities Using Compactly Supported Shearlets*, Dissertation, Technische Universität Berlin, 2016.
- [2] **P. Petersen**, *Applications of Shearlet Frames for a Sparsity Promoting Regularization of the Inverse Scattering Problem*, Masterarbeit, Technische Universität Berlin, 2013.
- [3] **P. Petersen**, *Nonnegative Completions of Block Operators*, Bachelorarbeit, Technische Universität Berlin, 2011.

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#### Invited Talks

- 2018 **Zurich Colloquium in Applied and Computational Mathematics**, ETH Zürich, Zürich, Schweiz, 19.09.2018
- PDE-CDT Summer School**, University of Oxford, United Kingdom, 3.-6.09.2018
- Interplay of tensor structured formats with advanced PDE discretizations**, WS Vienna, 11.-15.08.2018
- Analysis seminar**, KU Ingolstadt Eichstaett, 30.-31.05.2018
- Oberwolfach workshop**, “Applied Harmonic Analysis and Data Processing“, Mathematisches Forschungsinstitut Oberwolfach, 25.03.2018

- IAS Workshop on Mathematics of Deep Learning**, Hong Kong University of Science and Technology, 9-12.01.2018
- 2017 **Workshop on Mathematics of Deep Learning 2017**, Weierstrass Institute for Applied Analysis and Stochastics, 13–15.09.2017
- Reliable Methods of Mathematical Modeling**, HU Berlin, 31.07–04.08.2017
- International Workshop on Computational Harmonic Analysis**, Nankai University, Tianjin, China, 15–18.06.2017
- RTG  $\pi^3$  Seminar**, Universität Bremen, 29.03.2017
- 2016 **NuHAG seminar**, Universität Wien, Austria, 16.11.2016
- Analysis seminar**, Harbin Institute of Technology, Harbin, China, 05.08.2016
- Minisymposium**, “Geometry and Non-Linear Approximation”, Tønsberg, Norway, 27.06.2016
- Oberseminar zur Numerik**, Philipps-Universität Marburg, 15.06.2016
- 2015 **DMV15-minisymposium**, “Applied and Computational Harmonic Analysis”, Universität Hamburg, 23.09.2015
- Oberwolfach workshop**, “Applied Harmonic Analysis and Sparse Approximation”, Mathematisches Forschungsinstitut Oberwolfach, 21.08.2015
- 1. BIMoS Day**, “Compressed Sensing”, TU Berlin, 04.05.2015
- Oberwolfach-Workshop**, “New Discretization Methods for the Numerical Approximation of PDEs”, Mathematisches Forschungsinstitut Oberwolfach, 11.01.2015
- 2014 **Zurich Colloquium in Applied and Computational Mathematics**, ETH Zürich, Zürich, Schweiz, 12.11.2014
- Analysis Seminar**, Brandenburgische Technische Hochschule Cottbus, 06.10.2014

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## Research Visits

- 11/2016 **Universität Wien**, with *Prof. Dr. Philipp Grohs*, (1 week).
- 08/2016 **Harbin Institute of Technology**, with *Prof. Dr. Jianwei Ma*, (1 month).
- 11/2014 **ETH Zürich**, with *Prof. Dr. Philipp Grohs*, (1 week).
- 10/2014 **Technische Universität München**, with *Prof. Dr. Massimo Fornasier*, (2 months).

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## Membership in Professional Societies

American Mathematical Society (AMS)  
 Gesellschaft für Angewandte Mathematik und Mechanik (GAMM)  
 GAMM Activity Group on Mathematical Signal- and Image Processing  
 Berlin Mathematical School (BMS)

Berlin International Graduate School in Model and Simulation Based Research (BIMoS)

## Administrative Work

- 02/2019 Organizer of the minisymposium: Mathematics of Deep Learning" during the Annual Meeting of the GAMM in Vienna
- 12/2017 Organizer of the MATHEON Conference "Compressed Sensing and its Applications" at TU Berlin
- 05/2017 Organizer of the MATHEON Conference "Wavelet and Tensor Methods for Partial Differential Equations" at TU Berlin
- since 01/2016 Coordination of the Colloquium of the Modelling, Numerics, and Differential Equations Group
- since 06/2013 Coordination of the Seminar "Applied functional analysis" at TU Berlin
- 12/2015 Local coordinator of the 2. MATHEON Conference "Compressed Sensing and its Applications" at TU Berlin.
- 04/2014 Local coordinator of the joint GAMM ANLA-MSIP Workshops 2014 on "Matrix Computations for Sparse Recovery" at TU Berlin
- 12/2013 Local coordinator of the MATHEON Conference "Compressed Sensing and its Applications" at TU Berlin
- since 06/2013 Administration of the webpage of the GAMM Mathematical Signal and Image Processing Activity Group

## Grants

- 2018 Research scholarship of the DFG: "Shearlet-based energy functionals for anisotropic phase-field models"
- 2017 3. International MATHEON Conference on Compressed Sensing and its Applications
- 2017 MATHEON Conference on Wavelet and Tensor Methods for Partial Differential Equations

## Refereeing and Reviewing Work

### Referee for the following journals:

*Advances in Computational Mathematics*, Elsevier

*Applied and Numerical Harmonic Analysis*, Birkhäuser

*Communications in Nonlinear Science and Numerical Simulation*, Elsevier

*IEEE Access*, IEEE

*Journal of Approximation Theory*, Elsevier

*Journal of Fourier Analysis and Applications*, Springer

*Journal of Geometric Analysis*, Springer

*Signal, Image and Video Processing*, Springer

*Journal of Mathematical Imaging and Vision*, Springer

*Transactions on Medical Imaging, IEEE*

*International Journal of Wavelets, Multiresolution and Information Processing,*  
World Scientific