

# Johanna Beyer

## Curriculum Vitae

I am a research scientist at the Visual Computing Group at Harvard University. My main research interests are scalable techniques for high-throughput data visualization of large and complex scientific data, and the combination of abstract information visualization with scientific visualization for novel domain-specific applications. In addition, I am interested in immersive analytics, which uses Augmented and Virtual Reality to support visual analysis and decision-making.

I am passionate about teaching and teaching methodologies, which I use to teach undergraduate and graduate courses here at Harvard.

### Education

- 2004–2009 **Ph.D. in Computer Science**, *Vienna University of Technology*, Austria.  
Dissertation: *GPU-based Multi-Volume Rendering of Complex Data in Neuroscience and Neurosurgery*.  
Ph.D. committee: Prof. Dr. Eduard Gröller, Prof. Dr. Hanspeter Pfister.
- 2000–2004 **Dipl. Ing. (FH) in Medical Software Engineering**, *Upper Austrian University of Applied Science*, Austria.

### Research Experience

- 2022–now **Research Scientist**, *Visual Computing Group, Harvard University*, USA.
- 2016–2022 **Research Associate**, *Visual Computing Group, Harvard University*, USA.
- 2013–2016 **Postdoctoral Fellow**, *Visual Computing Group, Harvard University*, USA.
- 2013 **Visiting Research Fellow**, *Institute of Computer Graphics and Algorithms, Vienna University of Technology*, Austria.
- 2010–2013 **Postdoctoral Fellow**, *Geometric Modeling and Scientific Visualization Research Center, King Abdullah University of Science and Technology (KAUST)*, Saudi Arabia.
- 2009 **Visiting Research Fellow**, *Initiative on Innovative Computing, Harvard University*, USA.
- 2008–2010 **Researcher**, *Visualization Group, VRVis Research Center*, Austria.
- 2004–2008 **Junior Researcher**, *Medical Visualization Group, VRVis Research Center*, Austria.

### Teaching Experience

#### Classroom Teaching

- 2019–now **Lecturer**, *CS 271 - Topics in Data Visualization*, 16 undergraduate and graduate students. Harvard University. (Harvard Certificate of Teaching Excellence awarded).
- 2018–now **Head Teaching Fellow**, *CS 171 - Visualization*, 80 undergraduate and 30 online students. Harvard University. (Harvard Certificate of Distinction in Teaching awarded).
- 2018–now **Teaching Fellow**, *Data Visualization Workshop*, 30 students. Harvard DCE Professional Development.
- 2017 **Lecturer**, *CS 171 - Visualization*, 70 undergraduate and graduate students. Harvard University.
- 2015–2016 **Head Teaching Fellow**, *CS 171 - Visualization*, 240 undergraduate and online students. Harvard University.

- 2013–2014 **Senior Teaching Fellow**, *CS 171 - Visualization*, Harvard University.
- 2014 **Senior Teaching Fellow**, *CS 207 - Systems Development for Computational Science*, 70 graduate and online students. Harvard University.
- 2013 **Senior Teaching Fellow**, *CS 109 - Data Science*, 400 undergraduate, graduate, and online students. Harvard University.
- 2010–2012 **Teaching Fellow**, *Scientific Visualization*, KAUST.
- 2010–2012 **Teaching Fellow**, *GPU and GPGPU Programming*, KAUST.
- Student Co-Supervision and Mentoring**
- 2015–now Leader of the visualization subgroup of Prof. Pfister's lab, including student mentoring, Harvard University.
- 2013–now Supervision of Ph.D. students, Master's theses, and research interns, Harvard University.
- 2010–2012 Supervision of Master's theses and directed research, King Abdullah University of Science and Technology.
- 2009–2010 Supervision of Master's theses and directed research, VRVis Research Center.

## Awards

- 2021 Honorable Mention Award (top 5%), ACM CHI.
- 2020 Best Paper, IEEE SciVis Conference.
- 2014 Best Paper Honorable Mention, IEEE InfoVis Conference.
- 2014 Best Poster, BioVis.
- 2012 Best Paper Honorable Mention, IEEE SciVis Conference.
- 2008 Medvis Award (Karl-Heinz-Höhne-Preis), second place.
- 2007 Best Applications Paper Award, IEEE Visualization Conference.
- 2004 Best Student Project Award, Upper Austrian University of Applied Sciences.

## Academic Activities

- Committees**
- Workshop Co-Chair IEEE Vis 2021, 2022
- Papers Co-Chair IEEE Large Scale Data Analysis and Visualization (LDAV) 2021, 2022.
- Program Committee IEEE Vis 2021.
- Program Committee IEEE SciVis 2014–2015, 2017–2018. 2020.
- Program Committee SciVis Short Papers 2018–2019.
- Program Committee EuroVis 2014, 2016, 2019–2021.
- Program Committee EuroVis Short Papers 2012–2014, 2017–2018. 2020.
- Posters Chair IEEE Large Scale Data Analysis and Visualization (LDAV) 2015.
- Program Committee IEEE Large Scale Data Analysis and Visualization (LDAV) 2014, 2015, 2017, 2018.
- Program Committee EG Eurographics Workshop on Visual Computing for Biology and Medicine (VCBM) 2018–2019, 2020.
- Program Committee Eurographics Symposium on Parallel Graphics and Visualization (EGPGV) 2022.

- Conference Reviews IEEE Visualization Conference; ACM SIGGRAPH; ACM SIGGRAPH Asia; SC International Conference for High Performance Computing, Networking, Storage and Analysis; ACM CHI; Eurographics Conference on Visualization; IEEE Pacific Visualization Symposium; IEEE/EG International Symposium on Volume and Point-Based Graphics; Eurographics Symposium on Parallel Graphics and Visualization; IEEE Symposium on Large-Scale Data Analysis and Visualization; International Conference in Central Europe on Computer Graphics, Visualization and Computer Vision; Eurographics Workshop on Visual Computing for Biology and Medicine; Central European Seminar on Computer Graphics. IEEE VR.
- Journal Reviews IEEE Transactions on Visualization and Computer Graphics; IEEE Computer Graphics and Applications; Computer Graphics Forum; The Visual Computer; Computer Assisted Radiology and Surgery; Information Visualization; Computers in Biology and Medicine; Neuroinformatics.
- Other Bio+Med+Vis Spring School Co-Organizer with Jan Byška, Ingrid Hotz, Barbora Kozlíková, Torsten Möller, Renata Raidou, Noeska Smit, Hsiang-Yun Wu. May 2021.
- NII Shonan Meeting Co-Organizer on “Formalizing Biological and Medical Visualization” with Barbora Kozlíková, Renata Raidou, Timo Ropinski, Issei Fujishiro. February 2020.

## Grants and Grant Writing Experience

I helped conceptualize and write the following grant proposals:

- 2021-2024 NSF 2107328, *Situated Visual Information Spaces*, Co-PIs Hanspeter Pfister, Ari Kaufman, and James Tompkin.
- 2018-2021 NSF-FO 1835231, *Analyzing Synapses, Motifs and Neural Networks for Large-scale Connectomics*, Co-PIs Hanspeter Pfister and Jeff Lichtman.
- 2016-2021 OSR-2015-CCF-2533-01 KAUST Office of Sponsored Research, *Large-Scale Connectomics*, Co-PIs Hanspeter Pfister and Markus Hadwiger.
- 2013-2015 NSF OIA-1125087, *Bridging the Computational Semantic Gap: A Demand-Driven Framework for Portal-Based Chemistry, Astronomy, and Neurobiology*, Co-PI Hanspeter Pfister.
- 2013-2015 Harvard Cuda Center of Excellence, PI Hanspeter Pfister.
- 2008 WWTF ICT08-040, *SCALE-VS: Research on the Scalability and Confluence of Scientific Visualization and Interactive Segmentation*, PI: Markus Hadwiger.

## Scholarships

- 2011 Sabic Postdoctoral Fellowship, postdoctoral funding.
- 2008 Marshall Plan Scholarship, partial doctoral funding.

## Publications – Book Chapters

- 2019 J. Beyer, C. Hansen, M. Hlawitschka, I. Hotz, B. Kozlikova, G. Scheuermann, M. Stommel, M. Streit, J. Waschke, T. Wischgoll, Y. Wan. Case Studies for Working with Domain Experts. *Foundations of Data Visualization*.
- 2011 W.-K. Jeong, H. Pfister, J. Beyer, and M. Hadwiger. GPU-accelerated Brain Connectivity Reconstruction and Visualization in Large-Scale Electron Micrographs. *GPU Computing Gems, Vol 1*.

## Publications – Peer-Reviewed Journal Publications

- 2022 J. Troidl, C. Cali, E. Gröller, H. Pfister, M. Hadwiger, and J. Beyer. Barrio: Customizable Spatial Neighborhood Analysis and Comparison for Nanoscale Brain Structures. *Computer Graphics Forum (EuroVis)*.

- 2022 J. Beyer\*, J. Troidl\*, S. Boorboor, M. Hadwiger, A. Kaufman, and H. Pfister. A Survey of Visualization and Analysis in High-Resolution Connectomics. *Computer Graphics Forum (EuroVis)*.
- 2021 T. Lin, Y. Yang, J. Beyer, and H. Pfister. Labeling Out-of-View Objects in Immersive Analytics to Support Situated Visual Searching. *IEEE Transactions on Visualization and Computer Graphics*.
- 2021 H. Strobelt, J. Kinley, R. Krüger, J. Beyer, H. Pfister, and A. Rush. GenNI: Human-AI Collaboration for Data-Backed Text Generation. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2021 J. Beyer, Y. Yang, H. Pfister. Visualization Design Sprints for Online and On-Campus Courses. *IEEE Computer Graphics and Applications*.
- 2021 F. Gonda, X. Wang, J. Beyer, M. Hadwiger, J. W. Lichtman, and H. Pfister. VICE: Visual Identification and Correction of Neural Circuit Errors. *Computer Graphics Forum (EuroVis)*.
- 2020 P. Rautek, M. Mlejnek, J. Beyer, J. Troidl, H. Pfister, T. Theußl, and M. Hadwiger. Objective Observer-Relative Flow Visualization in Curved Spaces for Unsteady 2D Geophysical Flows. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*. **Best Paper Award**.
- 2020 Y. Yang, M. Cordeil, J. Beyer, T. Dwyer, K. Marriott, and H. Pfister. Embodied Navigation in Immersive Abstract Data Visualization: Is Overview+Detail or Zooming Better for 3D Scatterplots? *IEEE Transactions on Visualization and Computer Graphics (InfoVis)*.
- 2020 N. Sawada, M. Uemura, J. Beyer, H. Pfister, and I. Fujishiro. TimeTubesX: A Query-Driven Visual Exploration of Observable, Photometric, and Polarimetric Behaviors of Blazars. *IEEE Transactions on Visualization and Computer Graphics*.
- 2019 R. Krueger, J. Beyer, W.-D. Jang, N. W. Kim, A. Sokolov, P. K. Sorger, H. Pfister, and M. Hadwiger. Facetto: Combining Unsupervised and Supervised Learning for Hierarchical Phenotype Analysis in Multi-Channel Image Data. *IEEE Transactions on Visualization and Computer Graphics (VAST)*.
- 2018 J. Beyer, H. Mohammed, M. Agus, A. K. Al-Awami, H. Pfister, and M. Hadwiger. Culling for Extreme-Scale Segmentation Volumes: A Hybrid Deterministic and Probabilistic Approach. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2017 H. Mohammed, A. K. Al-Awami, J. Beyer, C. Cali, P. Magistretti, H. Pfister, and M. Hadwiger. Abstractocyte: A Visual Tool for Exploring Nanoscale Astroglial Cells. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2017 M. Hadwiger, A. K. Al-Awami, J. Beyer, M. Agus, and H. Pfister. SparseLeap: Efficient Empty Space Skipping for Large-Scale Volume Rendering. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2017 B. Bach, R. Sicat, J. Beyer, M. Cordeil, and H. Pfister. The Hologram in My Hand: How Effective is Interactive Exploration of 3D Visualizations in Immersive Tangible Augmented Reality?. *IEEE Transactions on Visualization and Computer Graphics (InfoVis)*.
- 2017 D. Haehn, J. Hoffer, B. Matejek, A. Suissa-Peleg, Ali. K. Al-Awami, L. Kementsky, F. Gonda, E. Meng, W. Zhang, R. Schalek, A. Wilson, T. Parag, J. Beyer, V. Kaynig, T. R. Jones, J. Tompkin, M. Hadwiger, J. W. Lichtman, and H. Pfister. Scalable Interactive Visualization for Connectomics. *Informatics*.
- 2015 A. K. Al-Awami, J. Beyer, D. Haehn, N. Kasthuri, J. W. Lichtman, H. Pfister, and M. Hadwiger. NeuroBlocks - Visual Tracking of Segmentation and Proofreading for Large Connectomics Projects. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2015 J. Beyer, M. Hadwiger, and H. Pfister. State-of-the-Art in GPU-Based Large-Scale Volume Visualization. *Computer Graphics Forum*.

- 2014 A. K. Al-Awami, J. Beyer, H. Strobel, N. Kasthuri, J. W. Lichtman, H. Pfister, and M. Hadwiger. NeuroLines: A Subway Map Metaphor for Visualizing Nanoscale Neuronal Connectivity. *IEEE Transactions on Visualization and Computer Graphics (InfoVis)*. **Best Paper Honorable Mention Award**.
- 2014 D. Haehn, S. Knowles-Barley, M. Roberts, J. Beyer, N. Kasthuri, J. W. Lichtman, and H. Pfister. Design and Evaluation of Interactive Proofreading Tools for Connectomics. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2013 J. Beyer, A. K. Al-Awami, N. Kasthuri, J. W. Lichtman, H. Pfister, and M. Hadwiger. ConnectomeExplorer: Query-Guided Visual Analysis of Large Volumetric Neuroscience Data. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*.
- 2013 J. Beyer, M. Hadwiger, A. Al-Awami, W.-K. Jeong, N. Kasthuri, J. W. Lichtman, and H. Pfister. Exploring the Connectome - Petascale Volume Visualization of Microscopy Data Streams. *IEEE Computer Graphics and Applications*.
- 2012 M. Hadwiger, R. Sicat, J. Beyer, J. Krüger, and T. Möller. Sparse PDF Maps for Non-Linear Multi-Resolution Image Operations. *ACM Transactions on Graphics (SIGGRAPH Asia)*.
- 2012 M. Hadwiger, J. Beyer, W.-K. Jeong, and H. Pfister. Interactive Volume Exploration of Petascale Microscopy Data Streams Using a Visualization-Driven Virtual Memory Approach. *IEEE Transactions on Visualization and Computer Graphics (SciVis)*. **Best Paper Honorable Mention Award**.
- 2010 W.-K. Jeong, J. Beyer, M. Hadwiger, R. Blue, C. Law, A. Vasquez, C. Reid, J. Lichtman, and H. Pfister. SSECRET and NeuroTrace: Interactive Visualization and Analysis Tools for Large-Scale Neuroscience Datasets. *IEEE Computer Graphics and Applications*.
- 2009 W.-K. Jeong, J. Beyer, M. Hadwiger, A. Vasquez, H. Pfister, and R. Whitaker. Scalable and Interactive Segmentation and Visualization of Neural Processes in EM Datasets. *IEEE Transactions on Visualization and Computer Graphics (Visualization)*.
- 2007 J. Beyer, M. Hadwiger, S. Wolfsberger, and K. Bühler. High-Quality Multimodal Volume Rendering for Preoperative Planning of Neurosurgical Interventions. *IEEE Transactions on Visualization and Computer Graphics (Visualization)*. **Best Applications Paper Award**.
- 2007 J. Beyer, C. Langer, L. Fritz, M. Hadwiger, S. Wolfsberger, and K. Bühler. Interactive Diffusion Based Smoothing and Segmentation of Volumetric Datasets on Graphics Hardware. *Methods of Information in Medicine*.

## Publications – Peer-Reviewed Conference Publications

- 2021 T. Lin, R. Singh, Y. Yang, C. Nobre, J. Beyer, M. A. Smith, and H. Pfister. Towards an Understanding of Situated AR Visualization for Basketball Free-Throw Training. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (ACM CHI)*. **Honorable Mention Award**.
- 2020 T. Lin, Y. Yang, J. Beyer, and H. Pfister. SportsXR – Immersive Analytics in Sports. *4th Workshop on Immersive Analytics: Envisioning Future Productivity for Immersive Analytics (at ACM CHI 2020)*.
- 2019 N. Ruta, N. Sawada, K. McKeough, M. Behrisch, and J. Beyer. SAX Navigator: Time Series Exploration through Hierarchical Clustering. *IEEE Visualization, Short Papers, 2019*.
- 2019 R. Roessler, C. Kelly, M. Behrisch, and J. Beyer. TexTiles: Exploring Patterns in Historical Discourse. *4th Workshop on Visualization for the Digital Humanities (at IEEE Vis '19), 2019*.
- 2019 L. Pentecost, U. Gupta, E. Ngan, J. Beyer, G.-Y. Wei, D. Brooks, M. Behrisch. CHAMPVis: Comparative Hierarchical Analysis of Microarchitectural Performance. *Workshop on Programming and Performance Visualization Tools (ProTools), 2019*.

- 2011 T. Hoell, J. Beyer, F. Gschwantner, P. Muigg, H. Doleisch, G. Heinemann, and M. Hadwiger. Interactive Seismic Interpretation with Piecewise Global Energy Minimization. *Proc. of IEEE Pacific Visualization*.
- 2008 J. Beyer, M. Hadwiger, T. Möller, and L. Fritz. Smooth Mixed-Resolution GPU Volume Rendering. *Proc. of IEEE International Symposium on Volume and Point-Based Graphics 2008*.
- 2007 J. Beyer, M. Hadwiger, S. Wolfsberger, C. Rezk-Salama, and K. Bühler. Segmentierungsfreie Visualisierung des Gehirns für Direktes Volume Rendering. *Proc. of Bildverarbeitung für die Medizin 2007*.

## Publications – Technical Reports, Talks and Posters

- 2020 J. Beyer, and H. Pfister. Design Sprints for Online and On-Campus Visualization Courses. *VisActivities: IEEE VIS Workshop on Data Vis Activities to Facilitate Learning, Reflecting, Discussing, and Designing*.
- 2020 M. Williams, E. Z. Hang, A. Adjabodjou, R. Krueger, and J. Beyer. QuVis: A Quantum Circuit Visualization Tool for Novices. *Poster at IEEE International Conference on Quantum Computing and Engineering (QCE20)*.
- 2017 H. Mohammed, A. K. Al-Awami, J. Beyer, C. Corrado Cali, P. Magistretti, H. Pfister, and M. Hadwiger. Abstractocyte: A Visual Tool for Exploring Nanoscale Astroglial Cell Morphology. *Poster at IEEE Pacific Visualization (PacificVis)*.
- 2016 J. Beyer, H. Strobelt, M. Oppermann, L. Deslauriers, and H. Pfister. Teaching Visualization for Large and Diverse Classes on Campus and Online. *Pedagogy of Data Visualization Workshop*.
- 2014 A. K. Al-Awami, J. Beyer, H. Strobelt, N. Kasthuri, J. W. Lichtman, H. Pfister, M. Hadwiger. NeuroLines - A Subway Map Metaphor for Visualizing Nanoscale Neuronal Connectivity. *Poster at 4th Symposium on Biological Data Visualization (BioVis)*. **Best Poster Award**.
- 2011 J. Beyer, M. Hadwiger, W. Jeong, H. Pfister, J. Lichtmann, and C. Reid. Demand-Driven Volume Rendering of Terascale EM Data. *SIGGRAPH 2011 Talks*.
- 2011 J. Beyer, M. Hadwiger, W. Jeong, H. Pfister. Distributed Terascale Volume Visualization Using a Shared Virtual Memory Space. *Poster at IEEE Symposium on Large-Scale Data Analysis and Visualization (LDAV)*.
- 2010 J. Beyer, M. Hadwiger, W. Jeong, H. Pfister, J. Lichtmann, and C. Reid. Distributed Multi-Level Out-of-Core Volume Rendering. *Poster at NVIDIA GPU Technology Conference (NVIDIA Research Summit)*.

## Courses

- 2018 J. Beyer, M. Hadwiger. GPU-Based Large-Scale Scientific Visualization. *SIGGRAPH Asia*.
- 2014 J. Beyer, M. Hadwiger, H. Pfister. A Survey of GPU-Based Large-Scale Volume Visualization. *Eurographics Conference on Visualization (EuroVis) - State of The Art Reports*.
- 2013 M. Hadwiger, J. Krüger, J. Beyer, S. Bruckner. GPU-Based Large-Scale Visualization. *SIGGRAPH Asia*.

## Invited Talks and Guest Lectures

- 2021 *Visual Computing for Exploring Nanoscale Brain Tissue in Connectomics*. EG Workshop on Visual Computing for Biology and Medicine (VCBM) Captstone.
- 2021 *Visualization for Neuroscience and Connectomics*. Bio+Med+Vis Spring School.



- 2020 *Bigger, Better, Faster, Stronger - Computational and Perceptual Scalability in Data Visualization*. Graz University of Technology.
- 2018 *Collaborating with Domain Experts*. Dagstuhl Seminar on Foundations of Data Visualization.
- 2017 *Guest lecture: Visualizing Spatial Data: Volumes and Flow*. COMPSCI 205: Computing Foundations for Computational Science. Harvard University.
- 2016 *Visualization for Connectomics*. Immersive Approaches to Biological Data Visualization. Cold Spring Harbor Laboratory.
- 2015 *Visualization for Connectomics*. Data Visualization Meeting. Broad Institute.
- 2015 *Data Visualization and Visual Computing for Life Sciences*. Visual Computing Center, King Abdullah University of Science and Technology.
- 2014 *NeuroLines: A Subway Map Metaphor for Visualizing Nanoscale Neuronal Connectivity*. CSAIL, Massachusetts Institute of Technology.
- 2012 *Interactive Volume Exploration of Petascale Microscopy Data*. Visual Computing Group, Harvard University.
- 2012 *Petascale Visualization for Neuroscience*. Workshop on Computational Biomedicine and Geophysics, Salt Lake City.
- 2011 *Petascale Visualization for Neuroscience*. Argonne National Labs.
- 2006 *High-Quality Real-Time Visualization of Medical Data*. European Workshop on basic techniques of microsurgery and cerebral revascularization.

## Conference Presentations

- 2022 *A Survey of Visualization and Analysis in High-Resolution Connectomics*. EuroVis
- 2020 Panelist at *Why should I stay in Academia? Bridging Generations of Researchers in Visualization*. IEEE Vis.
- 2019 *Bringing Immersive Vis into the Wild*. ACM Siggraph Frontiers Workshop on Immersive Visualization. ACM Siggraph.
- 2018 *Culling for Extreme-Scale Segmentation Volumes: A Hybrid Deterministic and Probabilistic Approach*. IEEE SciVis.
- 2018 *Holograms in My Hand*. BOF Immersive Visualisation for Science. Research, and Art, ACM Siggraph Asia.
- 2018 *Course on GPU-Based Large-Scale Scientific Visualization*. ACM Siggraph Asia.
- 2014 *A Survey of GPU-Based Large-Scale Visualization*. EuroVis.
- 2013 *Course on GPU-Based Large-Scale Visualization*. ACM Siggraph Asia.
- 2013 *ConnectomeExplorer: Query-Guided Visual Analysis of Large Volumetric Neuroscience Data*. IEEE SciVis.
- 2013 *Interactive Non-Linear Image Operations on Gigapixel Images*. NVIDIA GPU Technology Conference.
- 2012 *Terascale Volume Visualization in Neuroscience*. NVIDIA GPU Technology Conference.
- 2011 *Demand-Driven Volume Rendering of Terascale EM Data*. ACM Siggraph.
- 2009 *Scalable and Interactive Segmentation and Visualization of Neural Processes*. IEEE SciVis.
- 2008 *Smooth Mixed-Resolution GPU Volume Rendering*. IEEE Volume and Point-based Graphics.
- 2007 *High-Quality Multimodal Volume Rendering for Preoperative Planning of Neurosurgical Interventions*. IEEE Visualization.