Axel Ekman

Curriculum Vitae

Personal Profile

Accomplished research scientist with extensive experience in imaging, image processing, and volumetric data analysis. With a PhD in Physics from the University of Jyväskylä, I develop computational tools for scientific imaging, particularly in X-ray tomography. My work focuses on automated image processing pipelines and integrating machine learning to enhance microscopy and tomography analysis. I specialize in image processing, reconstruction, and analysis for large-scale volumetric datasets.

Technical skills

Programming	**Python 3**, **C++**, C, MatLab, Java, MPI, OpenCL
Image Processing	**NumPy**, std::vector, ImageJ
Machine Learning	**PyTorch**, scikit-learn, XGBoost, TensorFlow
Technical reporting	LaTeX, reveal.js

Experience

2021– **Independent Researcher**, *Rakta Network Oy*, Finland

- Offer consulting and software development services for mathematical and scientific applications, specializing in imaging, image processing, and analysis for large-scale volumetric data.

2018–2021 **Research Scientist**, *University of California*, San Francisco

- Provided computational support for internal and collaborative research projects at the National Center for X-ray Tomography.
- Maintained and developed the automated image processing pipeline.
- Integrated modern machine learning techniques into soft X-ray tomography

2016–2018 **Postdoctoral Scholar**, *University of California*, San Francisco

- Managed the image processing pipeline at the National Center for X-ray Tomography
- Worked on transforming raw images into final volumetric representations for both fluorescence and X-ray microscopes, ensuring high-quality results for scientific analysis.
- Developed and integrated a fully automatic alignment procedure into the image processing pipeline, reducing the time from acquisition to visualization from approximately 30 hours to 5 minutes.

2011–2016 **Doctoral Student**, *University of Jyväskylä*, Finland

- Conducted extensive theoretical and numerical research on random deposition networks, focusing on the impact of steric hindrance (physical obstruction) between constituents.
- Demonstrated that steric hindrance significantly influences the contact formation and statistical properties of these networks, even in dilute systems.
- Advanced the understanding of how physical obstructions impact the connectivity and formation of contacts in random fiber networks.

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Publications: `www.researchgate.net/profile/Axel_Ekman`

2010–2011 **Research associate**, *University of Jyväskylä*, Finland

- Utilized micro- and nano-scale X-ray CT to analyze paper and cardboard structures.
- Developed and implemented quantitative analysis tools for 3D tomographic images.
- Enhanced material characterization techniques through multidisciplinary collaboration.

Education

March 2016 **Doctor of Philosophy in Physics**, *University of Jyväskylä*

April 2011 **Master of Science in Physics**, *University of Jyväskylä*

April 2011 **Bachelor of Science in Physics**, *University of Jyväskylä*

Languages (CEFR)

Swedish	Native (C2)	Finnish	Native (C2)
English	Advanced (C1)	German	Elementary (A2)

Presentations

2020 Microscopy & Microanalysis, 2020, Virtaul Meeting — *Task Based Semantic Segmentation of Soft X-ray CT Images Using 3D Convolutional Neural Networks*

2019 ImageXD, 2019, Berkeley CA — *Lightning talk – Making User's lives easier and more productive*

2018 CAMERA Workshop, 2018, Berkeley CA — *Data based signal decimation using Machine Learning*

2017 CAMERA Workshop, 2017, Berkeley CA — *PSF Corrected Reconstruction in Soft X-ray Tomography (SXT)*

2017 Microscopy & Microanalysis, 2017, St.Louis MO — *PSF Corrected Reconstruction in Soft X-ray Tomography (SXT)*

2015 Statistical physics and mechanics of forms and shapes. Marienhamn, Finland — *Contact formation in random packing*

2012 Physics days. Joensuu, Finland — *The number of contacts in random fibre networks*

2012 International Paper Physics Conference. Stockholm, Sweden — *The number of contacts in random fibre networks*

Publications

Articles

Tyler H Coale, Valentina Loconte, Kendra A Turk-Kubo, Bieke Vanslembrouck, Wing Kwan Esther Mak, Shunyan Cheung, Axel Ekman, Jian-Hua Chen, Kyoko Hagino, Yoshihito Takano, et al. Nitrogen-fixing organelle in a marine alga. *Science*, 384(6692):217–222, 2024.

Simon Leclerc, Visa Ruokolainen, Alka Gupta, Axel Ekman, Jian-Hua Chen, Sergey Kapishnikov, Eric Dufour, Vesa Hytonen, Eva Pereiro, Tony McEnroe, et al. Progression of herpesvirus infection remodels mitochondrial organization and metabolism. *Biophysical Journal*, 123(3):521a, 2024.

Valentina Loconte, Kendra Turk-Kubo, Bieke Vanslembrouck, Wing Kwan Esther Mak, Axel Ekman, Jian-Hua Chen, Yoshihito Takano, Takeo Horiguchi, Mark A Le Gros, Kyoko Hagino, et al. Soft x-ray tomography reveals coordinated mechanism of division of an organelle-like endosymbiont and its host cell. *Biophysical Journal*, 123(3):105a, 2024.

Eleonora de Klerk, Yini Xiao, Christopher H Emfinger, Mark P Keller, David I Berrios, Valentina Loconte, Axel A Ekman, Kate L White, Rebecca L Cardone, Richard G Kibbey, et al. Loss of znf148 enhances insulin secretion in human pancreatic β cells. *JCI insight*, 8(11), 2023.

Jacob Marcus Egebjerg, Maria Szomek, Katja Thaysen, Alice Dupont Juhl, Suzana Kozakijevic, Stephan Werner, Christoph Pratsch, Gerd Schneider, Sergey Kapishnikov, Axel Ekman, et al. Automated quantification of vacuole fusion and lipophagy in saccharomyces cerevisiae from fluorescence and cryo-soft x-ray microscopy data using deep learning. *Autophagy*, pages 1–21, 2023.

Thomas Eng, Deepanwita Banerjee, Javier Menasalvas, Yan Chen, Jennifer Gin, Hemant Choudhary, Edward Baidoo, Jian Hua Chen, Axel Ekman, Ramu Kakumanu,

et al. Maximizing microbial bioproduction from sustainable carbon sources using iterative systems engineering. *Cell Reports*, 42(9), 2023.

Valentina Loconte, Jian-Hua Chen, Bieke Vanslembrouck, Axel A Ekman, Gerry McDermott, Mark A Le Gros, and Carolyn A Larabell. Soft x-ray tomograms provide a structural basis for whole-cell modeling. *The FASEB Journal*, 37(1):e22681, 2023.

Ludovic Autin, Brett A Barbaro, Andrew I Jewett, Axel Ekman, Shruti Verma, Arthur J Olson, and David S Goodsell. Integrative structural modelling and visualisation of a cellular organelle. *QRB Discovery*, 3:e11, 2022.

Jian-Hua Chen, Valentina Loconte, Mirko Cortese, Axel Ekman, Mark A Le Gros, Ralf Bartenschlager, Venera Weinhardt, and Carolyn A Larabell. Whole-cell quantitative imaging of structural changes induced by sars-cov-2 using soft x-ray tomography. *Biophysical Journal*, 121(3):301a–302a, 2022.

Jian-Hua Chen, Bieke Vanslembrouck, Axel Ekman, Vesa Aho, Carolyn A Larabell, Mark A Le Gros, Maija Vihinen-Ranta, and Venera Weinhardt. Soft x-ray tomography reveals hsv-1-induced remodeling of human b cells. *Viruses*, 14(12):2651, 2022.

Jian-Hua Chen, Bieke Vanslembrouck, Valentina Loconte, Axel Ekman, Mirko Cortese, Ralf Bartenschlager, Gerry McDermott, Carolyn A Larabell, Mark A Le Gros, and Venera Weinhardt. A protocol for full-rotation soft x-ray tomography of single cells. *STAR protocols*, 3(1):101176, 2022.

Axel Ekman, Jian-Hua Chen, Bieke Vanslembrouck, Carolyn A Larabell, Mark A Le Gros, and Venera Weinhardt. Extending of imaging volume in soft x-ray tomography. *bioRxiv*, pages 2022–05, 2022.

Angdi Li, Shuning Zhang, Valentina Loconte, Yan Liu, Axel Ekman, Garth J Thompson, Andrej Sali, Raymond C Stevens, Kate White, Jitin Singla, et al. An intensity-based post-processing tool for 3d instance segmentation of organelles in soft x-ray tomograms. *Plos one*, 17(9):e0269887, 2022.

Valentina Loconte, Jitin Singla, Angdi Li, Jian-Hua Chen, Axel Ekman, Gerry McDermott, Andrej Sali, Mark Le Gros, Kate L White, and Carolyn A Larabell. Soft x-ray tomography to map and quantify organelle interactions at the mesoscale. *Structure*, 30(4):510–521, 2022.

Valentina Loconte, Jitin Singla, Angdi Li, Jian-Hua Chen, Axel Ekman, Gerry McDermott, Andrej Sali, Kate L White, and Carolyn Larabell. Quantitative analysis of the intracellular organelle interaction using soft x-ray tomography. *Biophysical Journal*, 121(3):497a, 2022.

Bieke Vanslembrouck, Jian-hua Chen, Axel Ekman, Mark LeGros, and Carolyn Larabell. Soft x-ray tomography: a mesoscale bio-imaging technique to study single cells in 3d with automated segmentation tools for several sub-cellular structures. *Microscopy and Microanalysis*, 28(S1):1498–1500, 2022.

Zachary H. Levine, Edward J. Garboczi, Adele P. Peskin, Axel A. Ekman, Elisabeth Mansfield, and Jason D. Holm. X-ray computed tomography using partially coherent fresnel diffraction with application to an optical fiber. *Opt. Express*, 29(2):1788–1804, Jan 2021.

Kenneth Fahy, Venera Weinhardt, Maija Vihinen-Ranta, Nicola Fletcher, Dunja Skoko, Eva Pereiro, Pablo Gastaminza, Ralf Bartenschlager, Dimitri Scholz, Axel Ekman, et al. Compact cell imaging device (cocid) to provide insights into the cellular origins of viral infections. *Journal of Physics: Photonics*, 2021.

Valentina Loconte, Jian-Hua Chen, Mirko Cortese, Axel Ekman, Mark A Le Gros, Carolyn Larabell, Ralf Bartenschlager, and Venera Weinhardt. Using soft x-ray tomography for rapid whole-cell quantitative imaging of sars-cov-2-infected cells. *Cell reports methods*, 1(7):100117, 2021.

Carla C Polo, Miriam H Fonseca-Alaniz, Jian-Hua Chen, Axel Ekman, Gerry McDermott, Florian Meneau, José E Krieger, and Ayumi A Miyakawa. Three-dimensional imaging of mitochondrial cristae complexity using cryo-soft x-ray tomography. *Scientific Reports*, 10, 2020.

Soumya G Remesh, Subhash C Verma, Jian-Hua Chen, Axel A Ekman, Carolyn A Larabell, Sankar Adhya, and Michal Hammel. Nucleoid remodeling during environmental adaptation is regulated by hu-dependent dna bundling. *Nature Communications*, 11(1):1–12, 2020.

Venera Weinhardt, Jian-Hua Chen, Axel A. Ekman, Jessica Guo, Soumya G. Remesh, Michal Hammel, Gerry McDermott, Weilun Chao, Sharon Oh, Mark A. Le Gros, and Carolyn A. Larabell. Switchable resolution in soft x-ray tomography of single cells. *PLOS ONE*, 15(1):1–14, 01 2020.

Kate L. White, Jitin Singla, Valentina Loconte, Jian-Hua Chen, Axel Ekman, Liping Sun, Xianjun Zhang, John Paul Francis, Angdi Li, Wen Lin, Kaylee Tseng, Gerry McDermott, Frank Alber, Andrej Sali, Carolyn Larabell, and Raymond C. Stevens. Visualizing subcellular rearrangements in intact cells using soft x-ray tomography. *Science Advances*, 6(50), 2020.

Vesa Aho, ElinaMäntylä, Axel Ekman, Satu Hakanen, SallaMattola, Jian-Hua Chen, Venera Weinhardt, Visa Ruokolainen, Beate Sodeik, Carolyn Larabell, and Maija Vihinen-Ranta. Quantitative microscopy reveals stepwise alteration of chromatin structure during herpesvirus infection. *Viruses*, 11(10), 2019.

Venera Weinhardt, Jian-Hua Chen, Axel Ekman, Gerry McDermott, Mark A Le Gros, and Carolyn Larabell. Imaging cell morphology and physiology using x-rays. *Biochemical Society Transactions*, 47(2):489–508, 2019.

Axel Ekman, Venera Weinhardt, Jian-Hua Chen, Gerry McDermott, Mark A. Le Gros, and Carolyn Larabell. PSF correction in soft x-ray tomography. *Journal of Structural Biology*, 204(1):9 – 18, 2018.

Antti Koponen, Axel Ekman, Keijo Mattila, Ahmad M. Al-Qararah, and Jussi Timonen. The effect of void structure on the permeability of fibrous networks. *Transport in Porous Media*, pages 1–13, 2017.

Ahmad M Al-Qararah, Axel Ekman, Tuomo Hjelt, Harri Kiiskinen, Jussi Timonen, and Jukka A Ketoja. Porous structure of fibre networks formed by a foaming process: a comparative study of different characterization techniques. *Journal of microscopy*, 264(1):88–101, 2016.

Axel A Ekman, Jian-Hua Chen, Jessica Guo, Gerry McDermott, Mark A Le Gros, and Carolyn A Larabell. Mesoscale imaging with cryo-light and x-rays: Larger than molecular machines, smaller than a cell. *Biology of the Cell*, 2016.

Ahmad M Al-Qararah, Axel Ekman, Tuomo Hjelt, Jukka A Ketoja, Harri Kiiskinen, Antti Koponen, and Jussi Timonen. A unique microstructure of the fiber networks deposited from foam–fiber suspensions. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 482:544–553, 2015.

Arttu Miettinen, Axel Ekman, Gary Chinga-Carrasco, and Markku Kataja. Measuring intrinsic thickness of rough membranes: application to nanofibrillated cellulose films. *Journal of materials science*, 50(21):6926–6934, 2015.

Axel Ekman, Arttu Miettinen, Tuomas Tallinen, and Jussi Timonen. Contact formation in random networks of elongated objects. *Physical review letters*, 113(26):268001, 2014.

Axel Ekman, Arttu Miettinen, Tuomas Turpeinen, Kaj Backfolk, and Jussi Timonen. The number of contacts in random fibre networks. *Nordic pulp and paper research Journal*, 27(2):270, 2012.

Timo Karppinen, Risto Montonen, Marjo Määttänen, Axel Ekman, Markko Myllys, Jussi Timonen, and Edward Hæggström. Evaluating pulp stiffness from fibre bundles by ultrasound. *Measurement Science and Technology*, 23(6):065603, 2012.

Conferences & Workshops

Jian-Hua Chen, Axel Ekman, Venera Weinhardt, Valentina Loconte, Gerry Mc Dermott, Mark A. Le Gros, and Carolyn Larabell. Imaging sub-cellular 3d structures using soft x-ray microscopy. *Microscopy and Microanalysis*, page 1–2, 2020.

Axel Ekman, Jian-Hua Chen, Gerry Mc Dermott, Mark A. Le Gros, and Carolyn Larabell. Task based semantic segmentation of soft x-ray ct images using 3d convolutional neural networks. *Microscopy and Microanalysis*, page 1–3, 2020.

Valentina Loconte, Jian-Hua Chen, Axel Ekman, Mark A. Le Gros, Gerry Mc Dermott, Kate White, and Carolyn Larabell. Correlated soft x-ray and cryogenic fluorescence tomography is a powerful tool to explore the role of mitochondria-associated membranes in insulin secretory pathway. *Microscopy and Microanalysis*, page 1–2, 2020.

Venera Weinhardt, Jian-Hua Chen, Axel Ekman, Mark A. Le Gros, Gerry Mc Dermott, and Carolyn Larabell. Advances in soft x-ray tomography. *Microscopy and Microanalysis*, page 1–4, 2020.

Jian-Hua Chen, Axel Ekman, Venera Weinhardt, Gerry McDermott, Mark A. Le Gros, and Carolyn A. Larabell. Imaging cancer cells and their interactions within 3d microenvironment - a quantitative study using cryo soft x-ray tomography. *Biophysical Journal*, 116(3, Supplement 1):439a, 2019.

Carolyn A. Larabell, Jian-Hua Chen, Venera Weinhardt, Axel Ekman, Gerry McDermott, and Mark A. Le Gros. Ct scans of single cells with soft x-ray tomography. *Biophysical Journal*, 116(3, Supplement 1):331a, 2019.

Kate L. White, Jitin Singla, John Francis, Jian-Hua Chen, Axel Ekman, Carolyn Larabell, and Raymond C. Stevens. Mesoscale architecture of beta cells upon glucose and ex-4 stimulation. *Biophysical Journal*, 116(3, Supplement 1):431a, 2019.

Jian-Hua Chen, Rosanne Boudreau, Axel Ekman, Gerry McDermott, Mark LeGros, and Carolyn Larabell. Quantitative analyzing the spatial organization of the organelles in cancer cell using soft x-ray tomography. *Microscopy and Microanalysis*, 23(S1):1392–1393, 2017.

Axel Ekman, Tia E Plautz, Jian-Hua Chen, Gerry McDermott, Mark A Le Gros, and Carolyn Larabell. Psf corrected reconstruction in soft x-ray tomography (sxt). *Microscopy and Microanalysis*, 23(S1):978–979, 2017.

Gerry McDermott, Rosanne Boudreau, Jian-Hua Chen, Axel Ekman, Mark LeGros, Tia Plautz, and Carolyn A Larabell. The national center for x-ray tomography: Status update. *Microscopy and Microanalysis*, 23(S1):970–971, 2017.

Tia Plautz, Rosanne Boudreau, Jian-Hua Chen, Axel Ekman, Mark LeGros, Gerry McDermott, and Carolyn Larabell. Progress toward automatic segmentation of soft x-ray tomograms using convolutional neural networks. *Microscopy and Microanalysis*, 23(S1):984–985, 2017.

Theses

The effect of steric hindrance on the packing of elongated objects. University of Jyväskylä, Finalnd, 2016. Doctoral Thesis, Supervisor: Prof. Jussi Timonen.

Determining the number of fibre-fibre contacts in cardboard samples using tomographic imaging. University of Jyväskylä, Finalnd, 2011. Master's Thesis, Supervisor: Prof. Jussi Timonen.

Determining the layered permeability of wet-pressing with the aid of tomography. University of Jyväskylä, Finalnd, 2010. Bachelor's Thesis, Supervisor: Prof. Markku Kataja.

Books / Chapters

Axel Ekman, Jian-Hua Chen, Venera Weinhardt, Myan Do, Gerry McDermott, Mark A Le Gros, and Carolyn A Larabell. *Putting Molecules in the Picture: Using Correlated Light Microscopy and Soft X-Ray Tomography to Study Cells*, pages 1–32. Springer, 2019.

Axel A. Ekman, Tia E. Plautz andGerry McDermott, Mark A. Le Gros, and Carolyn A. Larabell. *Soft x-ray tomography: techniques and applications*. CRC-press, 2017.