

Curriculum vitæ – Oskar Elek

Personal Data

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Professional Interests

Computer graphics, data visualization, nature-inspired modeling, computational fabrication, computational astronomy, applications of fractal mathematics

Languages

- English – fluent, full professional proficiency
- Slovak – mother-tongue
- Czech – bilingual proficiency
- German, French – elementary proficiency

Education

Oct 2011 – May 2015: Dr-Ing (PhD equivalent) in Computer Graphics, at Max Planck Institute for Informatics and MMCI Cluster of Excellence at Saarland University, Saarbrücken, Germany

- thesis topic: “Efficient Methods for Physically-based Rendering of Participating Media”
- advisors: Tobias Ritschel, Hans-Peter Seidel

Oct 2008 – Sep 2011: Mgr (MSc equivalent) in Software Systems, at Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic

- specialization: Computer Graphics
- thesis topic: “Physically-based Clouds Rendering on GPU” (advised by Alexander Wilkie)
- graduated *summa cum laude*

Oct 2005 – Sep 2008: Bc (BSc equivalent) in Programming, at Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic

- thesis topic: “Rendering Planetary Atmospheres in Real-Time” (advised by Petr Knoch)

Employment and Positions

- Adjunct Lecturer at University of California in Santa Cruz (2020, 2021)
- Post-doctoral Researcher at University of California in Santa Cruz (02/2019–present)
- Visiting Researcher at NVIDIA Research Helsinki (10/2017–03/2018)
- Visiting Researcher at Institute of Science and Technology Austria (03–05/2017)
- Visiting Researcher at Max Planck Institute for Informatics (04–06/2016)
- Early-stage Researcher at Charles University in Prague within the Innovative Training Network “DISTRO” (06/2015–09/2018)
- Doctoral Researcher at Max Planck Institute for Informatics (10/2011–05/2015)
- Quality Assurance at Bohemia Interactive Simulations (07/2010–08/2011)
- Research and engineering intern at Saarland University in Saarbrücken (08–09/2010)
- C++ Programmer at Laboratory Imaging (07/2007–10/2008)
- Math and physics tutoring (2005–2010)

Skills and Experience

Technical experience:

object-oriented languages (C/C++, Java), GPU programming (CUDA, HLSL/GLSL, Taichi), 3D printing technology, functional languages (Python, Matlab, Mathematica, Javascript), source management (SVN/Git), \LaTeX , HTML/CSS, compilers construction (Flex, Bison), non-procedural languages (Prolog, Haskell), Unix Shell

Non-technical experience:

- giving lectures, talks and other oral presentations (both expert and non-expert audiences)
- writing advanced technical texts, typesetting, authoring graphics and other visual elements
- managing small teams of collaborators, programmers and non-programmers, student supervision
- co-organization of events (conferences, consortium meetings, workshops, team-building)

Grants and Fellowships

- Incubator Fellowship from UCSC Center for Research in Open Source Software, **2021-2022**, for developing the PolyPhy inter-disciplinary software project
- Fellowship from the European Commission’s Marie Skłodowska-Curie Actions under the Innovative Training Network “DISTRO”, **2015-2018**, for researching novel physically accurate methods of color prediction and optimization in 3D printing

Conference
and Journal
Publications

- **Elek O**, Burchett JN, Prochaska JX, Forbes AG: *Monte Carlo Physarum Machine: Characteristics of Pattern Formation in Continuous Stochastic Transport Networks*, MIT Artificial Life, **2022**
- Abramov D, Burchett JN, **Elek O**, Hummels C, Prochaska JX, Forbes AG: *CosmoVis: An Interactive Visual Analysis Tool for Exploring Hydrodynamic Cosmological Simulations*, IEEE Transactions of Visualization and Computer Graphics, **2022**
- **Elek O**, Zhang R, Sumin D, Myszkowski K, Bickel B, Wilkie A, Křivánek J, Weyrich T: *Robust and Practical Measurement of Volume Transport Parameters in Solid Photo-polymer Materials for 3D Printing*, OSA Optics Express, **2021**
- **Elek O**, Burchett JN, Prochaska JX, Forbes AG: *Polyphorm: Structural Analysis of Cosmological Datasets via Interactive Physarum Polycephalum Visualization*, IEEE Transactions of Visualization and Computer Graphics (presented at IEEE VIS), **2020**
- Simha S, Burchett JN, Prochaska JX, Chittidi JS, **Elek O**, Tejos N, Jorgenson R, Bannister KW, Bhandari S, Day CK, Deller AT, Forbes AG, Macquart J-P, Ryder SD, Shannon RM: *Disentangling the Cosmic Web Towards FRB 190608*, The Astrophysical Journal Letters, **2020**
- **Elek O**, Burchett JN, Prochaska JX, Forbes AG: *Monte Carlo Physarum Machine: An Agent-based Model for Reconstructing Complex 3D Transport Networks*, Proceedings of Artificial Life conference, **2020**
- Burchett J, **Elek O**, Tejos N, Prochaska JX, Tripp TM, Bordoloi R, Forbes AG: *Revealing the Dark Threads of the Cosmic Web*. The Astrophysical Journal Letters, **2020**
- Herholz S, Zhao Y, **Elek O**, Nowrouzezahrai D, Lensch H, Křivánek J: *Volume Path Guiding Based on Zero-Variance Random Walk Theory*. ACM Transactions on Graphics (presented at SIGGRAPH), **2019**
- **Elek O**, Křivánek J: *Towards a Principled Kernel Prediction for Spatially Varying BSSRDFs*. Proc. of Eurographics Workshop on Material Appearance, **2018**
- Herholz S, **Elek O**, Schindel J, Křivánek J, Lensch H: *A Unified Manifold Framework for Efficient BRDF Sampling based on Parametric Mixture Models*. Proc. of Eurographics Symposium on Rendering, **2018**
- **Elek O**, Sumin D, Zhang R, Weyrich T, Myszkowski K, Bickel B, Wilkie A, Křivánek J: *Scattering-aware Texture Reproduction for 3D Printing*. ACM Transactions on Graphics (Proc. SIGGRAPH Asia) 36(6), **2017**
- Herholz S, **Elek O**, Vorba J, Lensch H, Křivánek J: *Product Importance Sampling for Light Transport Path Guiding*. Computer Graphics Forum (Proc. EGSR) 35(4) (2nd Best Paper award), **2016**
- **Elek O**, Bauszat P, Ritschel T, Magnor M, Seidel H-P: *Progressive Spectral Ray Differentials*. Proc. of International Workshop on Vision, Modeling and Visualization (VMV), **2014**
- **Elek O**, Ritschel T, Dachsbacher C, Seidel H-P: *Principal-Ordinates Propagation for Real-Time Rendering of Participating Media* (extended version). Computers and Graphics 45, **2014**
- **Elek O**, Bauszat P, Ritschel T, Magnor M, Seidel H-P: *Spectral Ray Differentials*. Computer Graphics Forum (Proc. EGSR) 33(4) (Best Student Paper award), **2014**
- **Elek O**, Ritschel T, Dachsbacher C, Seidel H-P: *Interactive Light Scattering with Principal-Ordinate Propagation*. Proc. of Graphics Interface (Best Student Paper award), **2014**
- **Elek O**, Ritschel T, Seidel H-P: *Real-Time Screen-Space Scattering in Homogeneous Environments*. IEEE Computer Graphics & Applications 33(3) (Special Issue "Scattering"), **2013**
- **Elek O**, Ritschel T, Wilkie A, Seidel H-P: *Interactive Cloud Rendering Using Temporally-Coherent Photon Mapping* (extended version). Computers & Graphics 36(8), **2012**
- **Elek O**, Ritschel T, Wilkie A, Seidel H-P: *Interactive Cloud Rendering Using Temporally-Coherent Photon Mapping*. Proc. of Graphics Interface, **2012**
- **Elek O**, Kmoch P: *Real-Time Spectral Scattering in Large-Scale Natural Participating Media*. Proc. of Spring Conference on Computer Graphics, **2010**

Other
Publications

- Burchett JN, Abramov D, **Elek O**, Forbes AG: *Volumetric Reconstruction for Interactive Analysis of the Cosmic Web*, Vis Astro Data Challenge, **2020**
- Zhou H, **Elek O**, Anand P, Forbes AG: *Bio-inspired Structure Identification in Language Embeddings*, Visualization for Digital Humanities workshop, **2020**
- **Elek O**, Thomas MM, Forbes AG: *Learning Patterns in Sample Distributions for Monte Carlo Variance Reduction*, Technical report at ArXiv, **2019**
- Iser T, **Elek O**: *Real-time Light Transport in Analytically Integrable Quasi-heterogeneous Media*. Proc. of Central European Seminar on Computer Graphics, **2018**
- **Elek O**: *Efficient Methods for Physically-based Rendering of Participating Media*. PhD thesis at Max Planck Institute for Informatics and Saarland University in Saarbrücken, **2016**
- **Elek O**: *Rendering Natural Phenomena*. In *Encyclopedia of Color Science and Technology*, Springer, Luo Ronnier (Editor-in-chief), **2015**
- Cover image and summary of *Principal-Ordinates Propagation*. In *Informatik Spektrum* 38(2), April **2015**
- **Elek O**: *Physically-based Cloud Rendering on GPU*. MSc thesis at Charles University in Prague, **2011**
- **Elek O**, Wilkie A: *Layered Materials in Real-Time Rendering*. Proc. of Central European Seminar on Computer Graphics, **2010**
- **Elek O**, Kmoch P: *Rendering Parametrizable Planetary Atmospheres with Multiple Scattering in Real-Time*. Proc. of Central European Seminar on Computer Graphics, **2009**
- **Elek O**: *Rendering Planetary Atmospheres in Real-Time*. BSc thesis at Charles University in Prague, **2008**

Artworks and
Performances

- **Elek O**, Mossman W, Forbes A: *Sifting Strands*. Interactive artwork at IEEE VIS Arts Program, to be presented in Oklahoma City in October **2022**
- **Elek O** and Mossman W: *50 Shapes of Slime*. Interactive collaborative art installation at the Liminal Space event, Santa Cruz 11th Hour Cafe, **2022**

- **Elek O** and Mossman W: *Liminal Space*. Series of community-oriented live audiovisual performances, performed at Santa Cruz 11th Hour Cafe, **2022**
- **Elek O** and Burchett JN and Forbes AG: *Rhizome Cosmology*. Online outreach article presenting the main results of the Polyphorm project, available at <https://elek.pub/projects/Rhizome-Cosmology>. **2022**
- Mori I, **Elek O**, Burchett JN, Forbes AG: *Physarum Telam*. Interactive online artwork, presented at Artificial Life conference, **2021**
- **Elek O**: *As Above - So Below*. Exhibit at Santa Cruz Museum of Art and History, **2021**

Teaching and Mentoring

- Mentor for the *Google Summer of Code*, project PolyPhy as part of UCSC CROSS org, Summer 2022 (5 students worldwide)
- Instructor for the *Creative Coding* undergraduate course, UC Santa Cruz, Spring 2021 (~50 students)
- Instructor for the *Game Graphics and Real-time Rendering* undergraduate course, UC Santa Cruz, Spring 2020 (~100 students) and Winter 2021 (~50 students)
- Mentoring/co-mentoring students at UC Santa Cruz: Montana Fowler (PhD), Henry Zhou (PhD), Manu Mathew Thomas (PhD), David Abramov (PhD), Issei Mori (BSc), Kapil Gupta (MSc), Drew Ehrlich (BSc, MSc), Milad Hakimshafaei (PhD)
- Mentoring students at Charles University: Tomáš Iser (BSc), Federico Forti (MSc), Antonín Teichmann (BSc)
- Supervision of student team SW project *Pepr3d* (Tomáš Iser, Štěpán Hojdar, Luis Sanchez, Jindřich Pikora, Charles University, defended 05/2019)
- Teaching assistant for “Interactive Global Illumination” advanced seminar (SS 2014 at Saarland University in Saarbrücken, lead by Tobias Ritschel)

Academic Service

- Co-organizer of the UCSC Postdoc Symposium 2022
- Judge at the UCSC Graduate Student symposium 2022
- Judge at the Santa Cruz County Science Fair 2022 (elementary and middle school students in the Computers and Engineering category)
- Social Event Coordinator and board member at UCSC Postdoc Association (2021–22)
- Organizer and chair of the workshop Data Across Boundaries as part of the CROSS Symposium 2021
- IPC member for Eurographics Short Papers track (2019, 2020)
- Reviewer for SIGGRAPH Art Gallery (2021, 2022), SIGGRAPH Asia (2019, 2020), Transactions of Visualization and Computer Graphics (2016, 2020), IEEE Vis (2020), Eurographics (2014, 2016, 2020), SIGGRAPH (2015, 2019), Transactions of Graphics (2017, 2018), Computers and Graphics (2017, 2018), Computer Graphics Forum (2017), Graphics Interface (2013, 2014, 2015), GRAPP (2014), Pacific Graphics (2012)
- Organizer of the Autumn School of CG (IST Austria, 2017) for the researchers of the DISTRO ITN
- Reviewer for several Bc and MSc theses at Charles University in Prague
- Student volunteer and photographer at Eurographics Symposium on Rendering 2011 in Prague

Talks and Presentations (past 5 years)

- Talk at UCSC Postdoc Symposium (scientific audience): *Nurturing an interdisciplinary mindset in scholarly praxis*, **05/2022**
- Research presentation at UC Irvine Postdoc Symposium (scientific audience): *Polyphorm: What can primordial intelligence teach us about the Universe?*, **05/2022**
- Invited colloquium at New Mexico State University (scientific audience): *As Above / So Below: Learning from primitive intelligence in the quest for understanding the Universe's large scale structure*, **04/2022**
- Invited lecture at the Graphical Simulation of Physical Systems class of Worcester Polytechnic Institute (student audience): *As Above - So Below: What can primordial intelligence teach us about the Universe?*, **02/2022**
- Invited talk at IRIS-HEP topical meeting (scientific audience): *Polyphorm: Nature-inspired reconstruction and visualization of transport networks*, **11/2021**
- Artwork presentation at Artificial Life conference (scientific audience): *Physarum Telam*, **06/2021**
- Invited talk at USPA Postdoc Symposium (multi-disciplinary audience): *As Above - So Below*, **04/2021**
- Proposal talk at CROSS (industrial and academic reviewers): *Polyphorm*, **03/2021**
- Research presentation at UCSC Postdoc seminar (STEM postdocs): *Polyphorm: Interactive reconstruction and visualization of the Cosmic Web*, **01/2021**
- Invited talk with D. Abramov at RHyTHM conference (expert audience): *Unraveling the Cosmic Web*, **12/2020**
- Invited presentation at discussion panel on Data Visualization (public audience): *MCPM: Bio-inspired Reconstruction and Visualization of the Cosmic Web*, **11/2020**
- Invited talk at UCSC Computational Media Seminar (students and faculty): *Polyphorm*, **11/2020**
- Paper presentation at IEEE VIS conference (expert audience): *Polyphorm: Structural Analysis of Cosmological Datasets via Interactive Physarum Polycephalum Visualization*, **10/2020**
- Contributed talk at ALife conference (expert audience): *Monte Carlo Physarum Machine: An Agent-based Model for Reconstructing Complex 3D Transport Networks*, **07/2020**
- Research presentation at UCSC Creative Coding lab, Santa Cruz (lab members and colleagues): *Monte Carlo Physarum Machine: Current and Future Work*, **11/2019**
- Invited talk at USC's Gender and Engineering class (student audience): *Transformation is You*, **11/2019**
- Research presentation at UCSC's Applied AI Initiative seminar, Santa Cruz (specialized audience): *Monte Carlo Physarum Machine: Unconventional AI for Astronomy and Beyond*, **10/2019**
- Research presentation at UCSC's Applied AI Initiative seminar, Santa Cruz (specialized audience): *Learning Patterns in Sample Distributions for Monte Carlo Variance Reduction*, **06/2019**
- Lecture at Angus Forbes' CG course, Santa Cruz (student audience): *Volumetric Effects and Models*, **05/2019**

- Talk at UCSC Postdoc Symposium, Santa Cruz (broad scientific audience): *From Equations to Colors*, **04/2019**
- Introductory presentation at UCSC Creative Coding lab, Santa Cruz (lab members and colleagues): *Hello UCSC Creative Coding!*, **02/2019**
- Research presentation at Tübingen University, Germany (specialized audience): *Rethinking Color and Texture Reproduction in 3D Printing*, **07/2018**
- Paper presentation at EG Workshop on Material Appearance, Karlsruhe, Germany (professional audience): *Principled Kernel Prediction for Spatially Varying BSSRDFs*, **07/2018**
- Alumnus talk at Central European Seminar on Computer Graphics, Smolenice, Slovakia (broad scientific audience): *10 Years After*, **04/2018**
- Tutorial at Central European Seminar on Computer Graphics, Smolenice, Slovakia (student audience): *Scientific Writing, or How I learned to Stop Worrying and Love the Paper*, **04/2018**
- Research presentation at NVIDIA Helsinki, Finland (professional audience): *Advanced Color and Texture Reproduction in 3D Printing*, **03/2018**
- Progress presentations for DISTRO project, Zürich, Switzerland (consortium members), **02/2018**
- Paper presentation at SIGGRAPH Asia, Bangkok, Thailand (professional audience): *Scattering-aware Texture Reproduction for 3D Printing*, **11/2017**
- Lecture at the Week of Science festival, Academy of Sciences, Prague, Czechia (lay audience): *Computer Graphics – a Bridge between the Real and the Virtual*, **11/2017**
- Research presentation at NVIDIA Helsinki, Finland (team members): *Scattering-aware 3D printing – and what is next?*, **10/2017**
- Lecture and hands-on workshop at Autumn School of Graphics, Klosterneuburg, Austria (project members): *Advanced Color Reproduction in 3D Printing*, **10/2017**
- Research presentation at INRIA Institute, Sophia Antipolis, France (professional audience): *Scattering-aware Texture Reproduction for 3D Printing*, **10/2017**
- Progress presentations for DISTRO project, Prague, Czechia (consortium members), **02/2017**
- Seminar talk at Charles University, Prague, Czechia (students and group members): *Computational Modelling and Fabrication of Textured Translucency*, **02/2017**
- Faculty outreach presentation at the GAUDEAMUS Expo, Prague, Czechia (lay audience and students): *How Do Computers See the World?*, **01/2017**

Projects and Collaborations

PolyPhy, inter-disciplinary implementation of the generalized MCPM methodology designed for astrophysics, cosmology and data science experts

- spiritual successor of **Polyphorm**
- multi-platform port into Python and Taichi
- supported by incubator fellowship from UCSC Center for Research in Open Source Software (CROSS)
- role: lead architect and developer
- url: <https://github.com/PolyPhyHub/PolyPhy>
- development: Fall 2021–ongoing

CosmoVis, interactive web-based visualization and analysis of massive cosmological simulation datasets

- server-client software build with Javascript and WebGL
- supported by a Hubble Space Telescope agency grant led by Joseph N. Burchett (NMSU), David Abramov (UCSC) and Angus G. Formes (UCSC and Purdue)
- role: design and consulting regarding 3D visualization and rendering
- development: 2020–ongoing

ReeFormed, underwater sculpture and reef restoration project

- topic: led by Santa Cruz artist Colleen Flanigan, this collaboration aims to create a large underwater installation serving as both a coral nursery and an open artpiece for raising awareness about ocean health
- role: technical consulting regarding computational modeling and 3D printing
- development: 2020–ongoing

Polyphorm, research framework combining simulation and visualization elements

- topic: developed in collaboration with the astronomy department at UCSC as a means of reconstructing and visualizing the Cosmic web (the largest structure known to science) by the means of a nature inspired algorithm
- project gained substantial media attention after the release of its first scientific result in March 2020, featured in outlets including NASA, ESA, Hubble Space Telescope, Planetary Society, Popular Science, Sci Show, Seeker, Reddit, and many other science-oriented media
- url: <https://github.com/CreativeCodingLab/Polyphorm>
- role: lead developer, modeling and visualization
- development: 2019–2021

Pepr3d, student software project in cooperation with the Prusa Research company

- topic: 3D painting tool for geometric editing and automatic segmentation of multi-material prints for the FDM technology (to be incorporated in the company's supplied software toolkit)
- team: 4 developers
- url: <https://github.com/tomasiser/pepr3d>
- role: supervision, consulting, printer hacking
- developed in 2018–2019

HotEye, industry research and simulation project developed for the Saarstahl company in collaboration with Saarland University in Saarbrücken and German Institute for Artificial Intelligence research

- topic: development of a software simulation of an optical scanning system used for the detection of mechanical and structural defects on steel cables used in civil engineering
- team: 3 developers and one 3D artist
- role: design and development of the simulation, calculation and measurement of the physical properties of the real setup, development of auxiliary mathematical models, partial coordination of the team
- developed over the course of 9 weeks in August and September 2010
- the system produces images which are qualitatively equivalent to those produced by the real scanner

Flying Samurai, World War I combat flight simulator for the Software Project course at Charles University

- supervised by: Otakar Nieder
- team: 4 programmers and several external contributors
- role: graphics programmer, joint team leadership with Jan Beneš, managing external contributors
- developed over the course of approximately 15 months from specification to hand-in (2009–2010)
- defended with extra ECTS credits award in June 2010

AtmoVision, real-time planetary atmospheres renderer, accompanying application for my bachelor and master theses at Charles University

- first version developed over the course of approximately 6 months (2007–2008)
- further development until 2011

Awards and Honors

- **2021**: ALIFE Art Award (with I. Mori)
- **2020**: Winner of VisAstro data challenge (with D. Abramov, J. Burchett, A. Forbes)
- **2016**: 2nd Best Paper award at EGSR (with S. Herholz)
- **2014**: Best Student Paper award at EGSR
- **2014**: Michael A.J. Sweeney Award for Best Student Paper at Graphics Interface
- **2011**: MSc studies finished *summa cum laude*
- **2010**: Best SCCG Presentation Award
- **2009**: Merit scholarship at Charles University
- **2009**: Best CESC Paper Award
- **2009**: Best CESC Presentation Award

Extracurricular

biking, hiking, socializing, photography, film, scuba diving, coffee

Oskar Elek
Santa Cruz
July 21, 2022