

Curriculum vitae – Oskar Elek

Personal Data

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Professional Interests

Computer graphics (physically-based image synthesis aka rendering, appearance modelling, numerical simulation, Monte Carlo methods, volumetric media, GPGPU), computational fabrication, computer games, optics and color science, unconventional computing, fractals

Languages

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

Education

June 2015 – 2020 (exp.) PhD in Computer Science at Charles University in Prague, Czech Republic, within the European Commission's Marie Skłodowska-Curie Innovative Training Network "DISTRO"

- thesis topic: Physically-accurate Appearance Prediction and Fabrication
- advisor: Jaroslav Křivánek

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 Kmoč)

Employment and Positions

- Adjunct Lecturer at University of California in Santa Cruz (03/2020–06/2020, 01/2021–present)
- 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 under the Marie Skłodowska-Curie ITN "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), 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)

Conference
and Journal
Publications

- **Elek O**, Burchett JN, Prochaska JX, Forbes AG: *Polyphorm: Structural Analysis of Cosmological Datasets via Interactive Physarum Polycephalum Visualization*, 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

- **Elek O**: *As Above - So Below*, exhibit at Santa Cruz Museum of Art and History, **2021**
- 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**

Teaching and
Mentoring

- Instructor for Game Graphics and Real-time Rendering course, UC Santa Cruz, Spring 2020 (111 students) and Winter 2021 (45 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)
- Mentoring students at Charles University: Tomáš Iser (BSc), defended 06/2017; Federico Forti, defended 02/2018; Antonín Teichmann (BSc), defended 08/2019
- 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	<ul style="list-style-type: none"> • IPC member for Eurographics Short Papers track (2019, 2020) • Reviewer for SIGGRAPH Art Gallery (2021), 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) • Co-organization of 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)	<ul style="list-style-type: none"> • Invited talk with D. Abramov at RHyTHM conference (expert audience): <i>Unraveling the Cosmic Web</i>, 12/2020 • Invited presentation at discussion panel on Data Visualization (public audience): <i>MCPM: Bio-inspired Reconstruction and Visualization of the Cosmic Web</i>, 11/2020 • Invited talk at UCSC Computational Media Seminar (students and faculty): <i>Polyphorm</i>, 11/2020 • Paper presentation at IEEE VIS conference (expert audience): <i>Polyphorm: Structural Analysis of Cosmological Datasets via Interactive Physarum Polycephalum Visualization</i>, 10/2020 • Contributed talk at ALife conference (expert audience): <i>Monte Carlo Physarum Machine: An Agent-based Model for Reconstructing Complex 3D Transport Networks</i>, 07/2020 • Research presentation at UCSC Creative Coding lab, Santa Cruz (lab members and colleagues): <i>Monte Carlo Physarum Machine: Current and Future Work</i>, 11/2019 • Invited talk at USC's Gender and Engineering class (student audience): <i>Transformation is You</i>, 11/2019 • Research presentation at UCSC's Applied AI Initiative seminar, Santa Cruz (specialized audience): <i>Monte Carlo Physarum Machine: Unconventional AI for Astronomy and Beyond</i>, 10/2019 • Research presentation at UCSC's Applied AI Initiative seminar, Santa Cruz (specialized audience): <i>Learning Patterns in Sample Distributions for Monte Carlo Variance Reduction</i>, 06/2019 • Lecture at Angus Forbes' CG course, Santa Cruz (student audience): <i>Volumetric Effects and Models</i>, 05/2019 • Talk at UCSC Postdoc Symposium, Santa Cruz (broad scientific audience): <i>From Equations to Colors</i>, 04/2019 • Introductory presentation at UCSC Creative Coding lab, Santa Cruz (lab members and colleagues): <i>Hello UCSC Creative Coding!</i>, 02/2019 • Research presentation at Tübingen University, Germany (specialized audience): <i>Rethinking Color and Texture Reproduction in 3D Printing</i>, 07/2018 • Paper presentation at EG Workshop on Material Appearance, Karlsruhe, Germany (professional audience): <i>Principled Kernel Prediction for Spatially Varying BSSRDFs</i>, 07/2018 • Alumnus talk at Central European Seminar on Computer Graphics, Smolenice, Slovakia (broad scientific audience): <i>10 Years After</i>, 04/2018 • Tutorial at Central European Seminar on Computer Graphics, Smolenice, Slovakia (student audience): <i>Scientific Writing, or How I learned to Stop Worrying and Love the Paper</i>, 04/2018 • Research presentation at NVIDIA Helsinki, Finland (professional audience): <i>Advanced Color and Texture Reproduction in 3D Printing</i>, 03/2018 • Progress presentations for DISTRO project, Zürich, Switzerland (consortium members), 02/2018 • Paper presentation at SIGGRAPH Asia, Bangkok, Thailand (professional audience): <i>Scattering-aware Texture Reproduction for 3D Printing</i>, 11/2017 • Research presentation at NVIDIA Helsinki, Finland (team members): <i>Scattering-aware 3D printing – and what is next?</i>, 10/2017 • Lecture and hands-on workshop at Autumn School of Graphics, Klosterneuburg, Austria (project members): <i>Advanced Color Reproduction in 3D Printing</i>, 10/2017 • Research presentation at INRIA Institute, Sophia Antipolis, France (professional audience): <i>Scattering-aware Texture Reproduction for 3D Printing</i>, 10/2017 • Progress presentations for DISTRO project, Prague, Czechia (consortium members), 02/2017 • Seminar talk at Charles University, Prague, Czechia (students and group members): <i>Computational Modelling and Fabrication of Textured Translucency</i>, 02/2017 • Faculty outreach presentation at the GAUDEAMUS Expo, Prague, Czechia (lay audience and students): <i>How Do Computers See the World?</i>, 01/2017 • Lecture at the Week of Science festival, Academy of Sciences, Prague, Czechia (lay audience): <i>Computer Graphics – a Bridge between the Real and the Virtual</i>, 11/2016 • Seminar talk at Charles University, Prague, Czechia (students and group members): <i>Product Importance Sampling for Light Transport Path Guiding</i>, 10/2016 • Dissertation defense talk, Max Planck Institute for Informatics, Saarbrücken, Germany: <i>Efficient Methods for Physically-based Rendering of Participating Media</i>, 02/2016 • Introductory talk within the DISTRO project, London, United Kingdom: <i>Realistic Rendering</i>, 02/2016
Projects and Collaborations	<p>ReeFormed, underwater sculpture and reef restoration project</p> <ul style="list-style-type: none"> • 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: computational modeling, technical consulting • development: 2020–ongoing <p>Polyphorm, research framework combining simulation and visualization elements</p> <ul style="list-style-type: none"> • 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–ongoing

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
- role: supervision, consulting, printer hacking
- developed in 2018–2019

HotEye, industry research and simulation project developed for the Saarländische Metallwerke 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

- 2020:** Winner of VisAstro data challenge (with J. Burchett, D. Abramov, A. Forbes)
- 2016:** 2nd Best Paper award at EGSR
- 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 Activities

Sports, socializing, hiking, traveling, literature, drawing, photography, cinema, computer games, scuba diving, cooking, arguing, coffee (drinking, making), looking for the meaning of life (aka philosophy)

Oskar Elek
Santa Cruz
January 20, 2021