Kenny Gruchalla
Curriculum Vitae

Personal Information

Postal Address:	(*available upon request*) Golden, CO 80401
Office:	303-275-3713
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E-mail:	kenny.gruchalla@nrel.gov
Web:	http://gruchalla.github.io

Education

2009 **Ph.D. Computer Science**, *University of Colorado at Boulder*, Boulder, CO.
Thesis: Progressive Visualization-Driven Multivariate Feature Definition and Analysis
Advisor: Professor Elizabeth Bradley
GPA: 3.9/4.0

2003 **M.S. Computer Science**, *University of Colorado at Boulder*, Boulder, CO.
Thesis: Immersive Well-Path Planning: Investigating the added value of immersive visualization
Advisor: Professor Clayton Lewis
GPA: 3.9/4.0

1995 **B.S. Computer Science**, *New Mexico Institute of Mining and Technology*, Socorro, NM.
GPA: 3.5/4.0

Experience

National Renewable Energy Laboratory (NREL), Golden, CO (June 2009 - present)

Jun 2009 - present **Senior Scientist**, *Distinguished Member of Research Staff.*
I lead NREL's scientific data visualization efforts in support of renewable energy research, collaborating with NREL domain scientists in the visualization of complex, large, multivariate data.

University of Colorado at Boulder, Boulder, CO (April 2001 - Mar 2006, May 2011 - present)

May 2011 - present **Assistant Professor Adjunct**,
Department of Computer Science.
I conduct research and oversee student research in scientific data visualization.

Apr 2001 - Mar 2006 **Professional Research Assistant**,
CADSWES (Center for Advanced Decision Support for Water and Environmental Systems).
I worked in an interdisciplinary research center on the design and the development of a commercial graphically-based decision support software system implementing object-oriented simulation, rule-based simulation, and linear optimization to model watershed physical processes, water ownership, and policy.

Jan 2004 - Aug 2004 **Professional Research Assistant**,
Department of Molecular, Cellular, and Developmental Biology.
I collaborated on the design and development of a pilot study to investigate the added value of using immersive visualization as a molecular research tool.

Jul 2002 - Aug 2003 **Graduate Research Assistant**,
BP Center for Visualization.
I designed and developed an interactive 3D immersive application capable of integrating geological, geophysical, reservoir and well data with drilling and platform planning in an immersive virtual environment.

Colorado State University, Fort Collins, CO (October 2021 - present)

Oct 2021 - present **Affiliate Faculty**,
Richardson Design Center.
I am an advisor for the Richardson Design Center (RDC) and their VR graduate certificate program.

Red Canyon Engineering, Denver, CO (June 2000 - January 2009)

Jun 2003 - Jun 2009 **Research Scientist / Principal Software Engineer**.

Jun 2000 - Jun 2003 **Software Engineering Consultant**.
I authored SBIR and other new business proposals, developing and directing over $0.5M in grants and contracts. I also conducted software architecture and algorithm reviews for the Mars Odyssey and Genesis spacecraft programs.

National Center for Atmospheric Research (NCAR), Boulder, CO (May 2006 - October 2008)

May 2006 - Oct 2008 **Visitor Appointment**.
I collaborated on the design and development of VAPOR, a state-of-the-art volume visualization suite designed to interactively explore large-scale time-varying multivariate computational fluid dynamics (CFD) data.

Raytheon, Aurora, CO (July 1995 - February 2001)

Jul 2000 - Feb 2001 **Senior Analyst / Medical Officer**,
United States Antarctic Program
Raytheon Polar Services.
I managed the data acquisition and visualization laboratory aboard the National Science Foundation's Antarctic research vessel, the Nathaniel B. Palmer, providing scientific support to NSF grantees. I also sailed as Medical Officer (EMT) aboard the Palmer.

Oct 1997 - Jun 2000 **Technical Software Lead**,
Space and Science Systems, Raytheon Systems Corporation.
I designed and developed animated meteorological visualization tools for the Cape Canaveral and Vandenberg space lift ranges that included the development of both real-time and analysis visualization algorithms and image processing software for radar and satellite instrumentation. As the technical lead I served as technical mentor, providing technical guidance across projects and organizations.

Jul 1995 - Oct 1997 **Software Developer**,
Satellite Mission Management Organization, Hughes Space Systems *(purchased by Raytheon in 1997).*
I designed and developed a distributed satellite mission planning and scheduling software system that included interactive 2D computer graphic models of satellite and ground station resource allocation and 3D modeling tools used for satellite payload constraint analysis. I also helped design, develop, and maintain object-oriented class libraries designed for reuse and rapid development of satellite space and ground applications.

Brookhaven National Laboratory (BNL), Upton, NY (January 1994 - May 1994)

Jan 1994 - May 1994 **Science and Engineering Research Intern**,
Advanced Technology Division.
I designed and developed interactive 2D visualizations of subsurface radioactive waste plumes created by a physically-based model of the breach, leach, and transport of radioactive waste material.

Funding

October 2020 Collaborative Visualization and Analysis for the Control Room of the Future, **PI**
DOE/NREL LDRD

August 2019 Cluster Perception in Scatterplots, **PI**
DOE/NREL LDRD/PI4

April 2016 Advanced Energy Systems Design Architecture, **PI**
DOE/NREL LDRD

September 2014 Immersive Computational Steering & Modeling, **PI**
DOE/NREL LDRD

September 2014 Visualization and Simulation of a Manufacturing Line, **PI**
WFO-Abengoa

January 2013 Integrated Energy Management and Analysis for the ESIF's Computational Systems, **Co-PI**
DOE/NREL LDRD

September 2012 Novel Visualization and Analysis for Extreme-Scale Wind Turbine Array Simulations, **PI**
DOE/NREL LDRD

September 2010 Wind Turbine Array Fluid Dynamic and Aero-Elastic Simulations, **Co-investigator**
DOE/NREL LDRD

January 2009	Lunar Base Simulator, **PI** NASA Glenn Research Center
March 2005	MarsFlight – An Immersive and Interactive Mars Airplane Simulator, **Co-PI** NASA Glenn Research Center
March 2003	Immersive Technology for Engineering Education, **Co-investigator** University of Colorado Engineering Excellence Fund

Publications

Book Chapters:

- K. Gruchalla and N. Brunhart-Lupo. The Utility of Virtual Reality for Science and Engineering In W.R. Sherman (Ed.), *VR Developer Gems*, CRC Press, May 2019.
- E. Gould, S. Guerin, C. Smith, S. Smith, B. Bush and K. Gruchalla. Learning and Tracking Ad Hoc Fiducial Markers in Spatial Augmented Reality In J.G. Michopoulos, C.J.J. Paredis, D.W. Rosen, J.M. Vance (Eds.), *Advances in Computers and Information in Engineering Research Vol. 2* ASMEE Press June 2021.

Refereed Papers:

- H. Sitaraman, N. Brunhart-Lupo, M. Henry de Frahan, S. Yellapantula, B. Perry, J. Rood, R. Grout, M. Day, R. Binyahib, and K. Gruchalla. Visualizations of direct fuel injection effects in a supersonic cavity flameholder. *Physical Review Fluids*, 2021
- K. Gruchalla, S. Raghupathi, N. Brunhart-Lupo. Structure Perception in 3D Point Clouds *ACM SAP 2021*, September 2021
- N. Brunhart-Lupo, S. Yellapantula, K. Gruchalla, R. Grout. Visualization of Jet Impingement and Ignition in a Piston-cylinder Chamber. *Energy Visualization 2021*, June 2021
- M. Whitlock, D. Albers Szafir, K. Gruchalla. HydrogenAR: Interactive Data-Driven Presentation of Dispenser Reliability. *ISMAR 2020*, November 2020
- N. Brunhart-Lupo, B. Bush, K. Gruchalla, K. Potter, S. Smith. Collaborative Exploration of Scientific Datasets using Immersive and Statistical Visualization. *Improving Scientific Software. NCAR/TB-564+PROC*, August 2020
- A.L. Figueroa-Acevedo, C.-H. Tsai, K. Gruchalla, Z. Claes, S. Foley, J. Bakke, J. Okullo, A.J. Prabhakar. Visualizing the impacts of renewable energy growth in the U.S. Midcontinent. *IEEE Open Access Journal of Power and Energy*, January 2020
- B. Bugbee, B.W. Bush, K. Gruchalla, K. Potter, N. Brunhart-Lupo, V. Krishnan. Enabling Immersive Engagement in Energy System Models with Deep Learning. *Statistical Analysis and Data Mining: The ASA Data Science Journal*, June 2019
- P.A. Fleming, J. Annoni, L.A. Martinez, S. Raach, K. Gruchalla, A. Scholbrock, M. Churchfield, and J. Roadman. Investigation into the shape of a wake of a yawed full-scale turbine *Journal of Physics: Conference Series* volume 1037, June 2018
- S. Molnar and K. Gruchalla. Visualizing Electrical Power Systems as Flow Fields *Workshop for Visualisation in Environmental Sciences (EnvirVis 2018)*, June 2018
- P.A. Fleming, J. Annoni, M. Churchfield, L. Martinez, K. Gruchalla, M.J Lawson, and P.J. Moriarty. A simulation study demonstrating the importance of large-scale trailing vortices in wake steering *Wind Energy Science*, volume 3, May 2018
- P.A. Fleming, J. Annoni, M.J. Churchfield, L. Martinez, K.M. Gruchalla, M.J Lawson, and P.J. Moriarty. From wake steering to flow control *Wind Energy Science Discussions*, November 2017
- K. Gruchalla, N. Brunhart-Lupo, K. Potter, J. Clyne. Contextual Compression of Large-Scale Wind Turbine Array Simulations. *In proceedings of Workshop for Data Reduction for Big Scientific Data (DRBSD-2)*, November 2017
- B. Bush, N. Brunhart-Lupo, B. Bugbee, V. Krishnan, K. Potter, and K. Gruchalla. Coupling Visualization, Simulation, and Deep Learning for Ensemble Steering of Complex Energy Models. *In proceedings of Data Systems for Interactive Analysis DSIA'17*, October 2017
- B. Bugbee, C. Phillips, H. Egan, R. Elmore, K. Gruchalla, and A. Purkayastha. Prediction and characterization of application power use in a high-performance computing environment. *Statistical Analysis and Data Mining: The ASA Data Science Journal* February, 2017.
- G.A. Ferguson, V. Vorotnikov, N. Wunder, J. Clark, K. Gruchalla, T. Bartholomew, D.J. Robichaud, and G.T. Beckham. Ab Initio Surface Phase Diagrams for Coadsorption of Aromatics and Hydrogen on the Pt(111) Surface. *The Journal of Physical Chemistry C*, November 2016

- K. Gruchalla, J. Novacheck, A. Bloom. Visualization of the Eastern Renewable Generation Integration Study. *In Proceedings of SC16*, Salt Lake City, UT, November 2016
- C. Zhang, S. Santhanagopalan, M.J. Stock, N. Brunhart-Lupo, K. Gruchalla. Interpretation of Simultaneous Mechanical-Electrical-Thermal Failure in a Lithium-Ion Battery Module. *In Proceedings of SC16*, Salt Lake City, UT, November 2016.
- D. Macumber, K. Gruchalla, N. Brunhart-Lupo, M. Gleason, J. Abbot-Whitley, J. Robertson, B. Polly, K. Fleming, M. Schott. City Scale Modeling with OpenStudio. *In Proceedings of ASHRAE and IBPSA-USA SimBuild 2016.*
- N. Brunhart-Lupo, B. Bush, K. Gruchalla, S. Smith. Simulation Exploration through Immersive Parallel Planes. *In Proceedings of IEEE Workshop on Immersive Analytics,* March 2016.
- J. Hinkle, P.N. Ciesielski, K. Gruchalla, K.R. Munch, B.S. Donohoe. Biomass accessibility analysis using electron tomography. *Biotechnology for Biofuels* volume 8, November 2015.
- S. Li, K. Gruchalla, K. Potter, J. Clyne, and H. Childs. Evaluating the Efficacy of Wavelet Configurations on Turbulent-Flow Data. in *In Proceedings of IEEE Symposium on Large Data Analysis and Visualization*, Chicago, IL, 2015.
- M. Lunacek, A. Nag, D. Alber, K. Gruchalla, C.H. Chang, and P.A. Graf. Simulation characterization and optimization of metabolic models with the high-performance systems biology toolkit. *SIAM Journal on Scientific Computing*, volume 33, pages 3402-3424, 2011.
- K. Gruchalla, M. Rast, E. Bradley, and P. Mininni. Segmentation and visualization of multivariate features using feature-local distributions. In *Advances in Visual Computing*, volume 6938 of *Lecture Notes in Computer Science*, pages 619–628. Springer Berlin / Heidelberg, 2011.
- M.A. Sprague, P.J. Moriarty, M.J. Churchfield, K. Gruchalla, S. Lee, J.K. Lundquist, J. Michalakes, and A. Purkayastha. Computational modeling of wind-plant aerodynamics. In Proceedings of *SciDAC 2011, Denver, CO*, 2011.
- M. Guy, P. Earle, C. Ostrum, K. Gruchalla, and S. Horvath. Integration and dissemination of citizen reported and seismically derived earthquake information via social network technologies. In *Advances in Intelligent Data Analysis IX*, volume 6065 of *Lecture Notes in Computer Science*, pages 42–53. Springer Berlin / Heidelberg, 2010.
- J. Clyne, K. Gruchalla, and M. Rast. VAPOR: Visual, Statistical, and Structural Analysis of Astrophysical Flows. In Proceedings of *Numerical Modeling of Space Plasma Flows: Astronum-2009 (Astronomical Society of the Pacific Conference Series)*, volume 429, pages 323-329, 2010.
- K. Gruchalla, M. Rast, E. Bradley, J. Clyne, and P. Mininni. Visualization-driven structural and statistical analysis of turbulent flows. In *Advances in Intelligent Data Analysis VIII*, volume 5772 of *Lecture Notes in Computer Science*, pages 321–332. Springer Berlin / Heidelberg, 2009.
- K. Gruchalla, M. Dubin, J. Marbach, and E. Bradley. Immersive examination of the qualitative structure of biomolecules. In Proceedings of *International Workshop on Qualitative Reasoning about Physical Systems*, pages 36–41, 2008.
- K. Gruchalla, J. Marbach, and M. Dubin. Porting legacy applications to immersive virtual environments - a case study. In Proceedings of *International Conference on Computer Graphics Theory and Applications (GRAPP 2007)*, pages 179–184, 2007.
- K. Gruchalla. Immersive well-path editing: investigating the added value of immersion. In Proceedings of *IEEE Virtual Reality, 2004.*, pages 157 – 164, March 2004.

Non-refereed Papers:

- M. Lawson, J. Melvin, S. Ananthan, K. Gruchalla, J. Rood, M. Sprague. Blade-Resolved, Single-Turbine Simulations Under Atmospheric Flow NREL Technical Report No. *NREL/TP-5000-72760*, January 2019.
- B. Palmintier, J. Giraldez, K. Gruchalla, P. Gotseff, A. Nagarajan, T. Harris, B. Bugbee, M. Baggu, J. Gantz, E. Boardman. Feeder Voltage Regulation with High Penetration PV using Advanced Inverters and a Distribution Management System: A Duke Energy Case Study NREL Technical Report No. *NREL/TP-5D00-65551*, November 2016.
- A. Bloom, A. Townsend, D. Palchak, J. Novacheck, J. King, C. Barrows, E. Ibanez, M. O'Connell, G. Jordan, B. Roberts, C. Draxl, K. Gruchalla. Eastern Renewable Generation Integration Study. NREL Technical Report No. *NREL/TP-6A20-64472*, August 2016.
  NREL 2017 Innovation & Technology Transfer Outstanding Public Information Award

- R. Elmore, K. Gruchalla, C. Phillips, A. Purkayastha, N. Wunder. An Analysis of Application Power and Schedule Composition in a High-Performance Computing Environment. NREL Technical Report No. *NREL/TP-2C00-65392*, January 2016.
- R.W. Grout, K. Malhorta, P. Ciesielski, K. Gruchalla, B. Donohoe, M. Nimlos. Computational Assessment of the effect of realistic intraparticle geometry on biomass heating rates and pyrolysis yields. *8th US National Combustion Meeting*, May 2013.
- G. Pech, K. Gruchalla, and J. Marbach. The case for visualization. *Exploration & Production*, January 2009.
- G.A. Dorn, G.S. Pech, K. Gruchalla, J. Marbach The Value of Visualization in Exploration and Production: Anecdotal Evidence and Quantitative Data *70th EAGE Conference & Exhibition-Workshops and Fieldtrips* June 2008.
- K. Gruchalla and J. Marbach. Interactively exploring multiple characteristics of hurricane simulation data. *Advanced Imaging*, 22, 2005.
- G. Dorn, K. Gruchalla, J. Carlson, J. Marbach, T. Southren, and A. Jamieson. A visualization-driven paradigm for adaptive well-path planning. In *Offshore Technology Conference*, 2004.
- K. Gruchalla and E. Joynt. Late Cretaceous and Cenozoic Reconstructions of the Southwest Pacific, Data Report NBP00-07B. United States Antarctic Program, 2000.
- K. Bliss, K. Gruchalla, and K. Gavahan. OBS Refraction Profiling for Crustal Structure in Bransfield Strait, Data Report NBP00-07A. United States Antarctic Program, 2000.

Video (selected):

- H. Sitaraman, M. Henry De Frahan, S. Yellapantula, B. Perry, J. Rood, R. Grout, M. Day, N. Brunhart-Lupo, R. Binyahib, K. Gruchalla. Direct fuel injection effects in a supersonic cavity flameholder *APS Division of Fluid Dynamics Gallery of Fluid Motion*, Chicago, IL, 2020.
  Gallery Award
- S. Witter Hicks, M. Churchfield, K. Gruchalla. Visualization of a Simulated LiDAR-Based Wind Turbine Wake Measurement Campaign, *SuperComputing 2016 (SC16), Salt Lake City, UT, November, 2016.*
- K. Gruchalla, M.J. Churchfield, P.J. Moriarty, , S. Lee S. Li, J.K. Lundquist, J. Michalakes, A. Purkayastha, and M.A. Sprague. Computational modeling of turbine-wake effects. *SciDAC 2011*, Denver, CO, 2011.
  Awarded SciDAC 2011 People's Choice Award
- K. Gruchalla, O. Desjardins, P. Pepiot, and A. Purkayastha. Numerical simulation of a turbulent liquid jet. *SuperComputing 2010 (SC10)*, New Orleans, LA, 2010.
- K. Gruchalla, M.J. Churchfield, P.J. Moriarty, and L. Martinez. Eddy simulation of wind farm / atmospheric boundary layer interaction. *SuperComputing 2010 (SC10)*, New Orleans, LA, 2010.
- K. Gruchalla, P. Pepiot, and O. Desjardins. Particle dynamics in a fluidized bed reactor. *SciDAC 2010*, Chattanooga, TN, 2010.
  Awarded SciDAC 2010 Outstanding Achievement in Scientific Visualization
- K. Gruchalla and J. Marbach. Atmosv: Immersive visualization of the hurricane Isabel dataset. *IEEE Visualization 2004*, Austin, TX, 2004.
  Awarded second place in the 2004 IEEE Visualization Contest

Motion Picture Credits:

- K. Gruchalla. Computer Graphics Rendering, *Green China Rising*. National Geographic Film, 2012.

Thesis:

- K. Gruchalla. *Progressive Visualization-Driven Multivariate Feature Definition and Analysis*. PhD thesis, University of Colorado at Boulder, 2009.
- K. Gruchalla. *Immersive well-path planning: The added value of immersive visualization.* Master's thesis, University of Colorado at Boulder, 2003.

***Posters** (selected):*

- M. Sprague, S. Ananthan, K. Gruchalla, M. Lawson, J. Rood, K. Swirydowicz, S. Thomas, G. Vijayakumar, P. Crozier, C.R. Dohrmann, J.J. Hu, A.B. Williams, J. Turner, A. Prokopenko, R. Moser, and J. Melvin. ExaWind: Exascale Predictive Wind Plant Flow Physics Modeling. Poster at *2019 Exascale Computing Project Annual Meeting*, Houston, TX. January 2019.
- B. Bugbee, C. Phillips, K. Gruchalla, R. Elmore, and A. Purkayastha. Exploring HPC Application Power Usage. Poster at *2016 Conference on Data Analysis (CODA),* Santa Fe, NM, 2016.

- J. Hinkle, P. Ciesielski, K. Gruchalla, B. Donohoe, and K. Munch. Segmentation of Lamellar Sheets of Cellulose using Electron Tomography. Poster at *2014 Annual BioEnergy Science Center (BESC) Retreat*, Chattanooga, TN, 2014.
- H. Scharf, K. Gruchalla, R. Elmore, N. Brunhart-Lupo, A. Purkayastha. Optimal Prioritized Compression using Wavelets for Analysis and Visualization of Extreme-Scale Wind Turbine Simulations. Poster at *2014 Conference on Data Analysis (CODA),* Santa Fe, NM, 2014.
- R. Elmore, M. Sheppy, N. Wunder, K. Munch, K. Gruchalla, A. Purkayastha. A Case Study in Demand-Response Strategies for Managing Power in HPC Environments. Poster at *2014 Conference on Data Analysis (CODA),* Santa Fe, NM, 2014.
- M. Dubin, A. Pardi, and K. Gruchalla. Using immersive virtual reality for visualization of macromolecules. Poster at *2004 Butcher Symposium on Genomics and Biotechnology,* Boulder, CO, 2004.
- K. Gruchalla and J. Marbach. Atmosv: Immersive visualization of the Hurricane Isabel dataset. Contest Entry at *IEEE Visualization 2004*, Austin, TX, 2004.
  Awarded second place in the 2004 IEEE Visualization Contest

***Press** (selected):*

- 38th Annual Gallery of Fluid Motion award winners announced, *AAAS EurekAlert!, November 2020.*
- The Man Behind the Goggles: Meet NREL's Visualization Guru, *NREL News, June 3, 2019.*
- R. Gold, Superpower: One Man's Quest to Transform American Energy. Simon & Schuster, June 2019.
- Decoding the Weather Machine. *PBS Nova*, Episode 7, Season 45, April 2018.
- Scientists Break This Virtual Power Grid to Save the Real One. *Popular Mechanics*, July/August 2015.
- Daley, D. Visualize the Future: Simulation helps NREL troubleshoot scenarios yet to happen. *Sound & Communications*, August 2014. (Cover article)
- Scanlon, W. Scientists go eye to eye with research at ESIF. *NREL News Feature*, July 2013. (http://www.nrel.gov/news/features/feature_detail.cfm/feature_id=2254)
- Pierce, E.R. Tour the National Renewable Energy Lab's Latest Research Center *energy.gov* June 2013. (http://energy.gov/articles/slideshow-tour-national-renewable-energy-lab-s-latest-research-center)
- Tucker, E. Supercomputing Drives Innovation. *Continuum Magazine*, (2), 6-9. 2012.
- Mosher. D. 10 Award-Winning Scientific Simulation Videos *Wired.com Wired Science* August 2011. (http://www.wired.com/wiredscience/2011/08/science-simulation-videos/)

Presentations (selected)

Keynotes

- "Immersive Analytics: Knowledge Discovery from the Inside," Keynote Address to the 2016 CSU Virtual Reality Symposium, Fort Collins, CO, October 2016.
- "Scientific Data Analysis and Knowledge Discovery through Advanced Visualization," Keynote Address to the 2016 CAAV Conference, Denver, CO, June 2016.

Invited

- "Visualization-Supported Energy Analysis for Resilient Cities," Workshop on Urban Visualisation: Energy Resilient Cities, Melbourne, Australia (virtual due to COVID-19). June 2020.
- "NREL Visualization Overview," Electronic Visualization Lab, University of Illinois, Chicago, IL. June 2019.
- "NREL Visualization Overview," SCI Institute, University of Utah, Salt Lake City, UT. May 2019.
- "NREL Visualization Overview," Emerging Analytics Center, University of Arkansas, Little Rock, AR. April 2019.
- "Computational Science," JeffCon 2019, Golden, CO, January 2019.
- "Immersive Analytics: Knowledge Discovery from the Inside," LANL Information Science and Technology Institute (ISTI) Seminar, Los Alamos National Laboratory, NM, July 2016.
- "Visualization and Analysis of Large-Scale Wind Turbine Array Simulations," Boulder Fluids Dynamics Seminar, Boulder, CO, February 2015.
- "Enabling Renewable Energy Research through Scientific Visualization," Data Visualization Summit, Boston, MA, September 2013.

- "Computational Modeling and Visualization of Turbine-Wake Effects," Frontiers in Computational Physics, Boulder, CO, December 2012.
- "Visualization-Driven Multivariate Feature Analysis using Feature-Local Distributions," Colorado School of Mines, Joint Colloquia of AMS and EECS, Golden, CO, December 2011.
- "Enabling Renewable Energy Research through Scientific Visualization," University of Colorado, Department of Computer Science Colloquium, Boulder, CO, March 2011.
- "Statistically Guided Multivariate Visualization and Analysis of Turbulence Structures," National Renewable Energy Laboratory (NREL), Golden, CO, April 2009.
- "Interactive visualization and analysis of turbulence structures and their statistics," Laboratory of Computational Dynamics Turb-Helio Seminar. Boulder, Colorado, February 2009.
- "Extending VAPOR's hardware-accelerated volume rendering capabilities," Computational and Information Systems Laboratory (CISL) Seminar, National Center for Atmospheric Research (NCAR). Boulder, Colorado, August 2007.
- "Multivariate volume visualization," Laboratory of Computational Dynamics Turb-Helio Seminar. Boulder, Colorado, November 2005.

Contributed

- "Structure Perception in 3D Point Clouds," *ACM Symposium on Applied Perception*, Paris, France (virutal), September 2021.
- "Knowledge Discovery through Immersive Analytics," *High Performance Computing Symposium 2021*, Boulder, CO, May 2021.
- "Visualization Paradigms in the Renewable Energy Space," *2019 IEEE VisWeek*, Application Spotlight, Vancouver BC, Canada, October 2019
- "Visualizing Electric Power Systems as Flow Fields," *2019 DOE Computer Graphics Forum*, Monterey, CA, March 2019
- "Contextual Compression of Large-Scale Wind Turbine Array Simulations," *Workshop for Data Reduction for Big Scientific Data, SC17*, Denver, CO, November 2017
- "Coupling Visualization, Simulation, and Deep Learning for Ensemble Steering of Complex Energy Models," *DSIA: Data Systems for Interactive Analysis*, Phoenix, AZ, October 2017
- "Visualization of a Simulated LiDAR-Based Wind Turbine Wake Measurement Campaign," *RMACC High Performance Computing Symposium 2017*, Boulder, CO, August 2017
- "Interpretation of Simultaneous Mechanical-Electrical-Thermal Failure in a Lithium-Ion Battery Module," *SuperComputing 2016 (SC16)*, Salt Lake City, UT, November 2016
- "Visualization of the Eastern Renewable Generation Integration Study.," *SuperComputing 2016 (SC16)*, Salt Lake City, UT, November 2016
- "Virtual Reality Panel," *2016 CSU Virtual Reality Symposium*, Fort Collins, CO, October 2016
- "Transmission Grid Visualization," *Grid Modernization Laboratory Consortium: Tools and Data for Production Cost Modeling Workshop*, Golden, CO, October 2016.
- "ESIF Insight Center: Visualization Hardware Panel," *2013 DOE Computer Graphics Forum*, Portland, OR, April 2013
- "Quantifying and Meshing Features in Microscopy Data," *2012 NREL High-Performance Computing Workshop*, Golden, CO, August, 2012
- "Visual Analysis of Fluidized Bed Reactor Dynamics," DOE Computer Graphics Forum, Albuquerque, NM, April 2012.
- "Segmentation and visualization of multivariate features using feature-local distributions," *International Symposium on Visual Computing 2011*, Las Vegas, NV, September, 2011
- "The Dawn of Scientific Visualization at NREL," *2010 DOE Computer Graphics Forum*, Park City, Utah, April 2010.
- "Visualization-Driven Structural and Statistical Analysis of Turbulent Flows," *2009 Intelligent Data Analysis Conference*, Lyon, France, September 2009.
- "Immersive Examination of the Qualitative Structure of Biomolecules," *2008 International Workshop on Qualitative Reasoning about Physical Systems*, Boulder, Colorado, June 2008.
- "Porting legacy applications to immersive virtual environments – a case study," *The 2007 International Conference on Computer Graphics Theory and Applications*, Barcelona, Spain, March 2007.
- "Hardware-accelerated visualization of non-uniformly gridded volume data," *2007 DOE Computer Graphics Forum*, Peaceful Valley, Colorado, May 2007.

- "Accounting network visualization," 2005 Annual RiverWare User Group Meeting, Boulder, Colorado, March 2005.
- "Optimization and rules policy editor," 2005 Annual RiverWare User Group Meeting, Boulder, Colorado, March 2005.
- "Workspace migration to Qt," 2005 Annual RiverWare User Group Meeting, Boulder, Colorado, March 2005.
- "Immersive well-path editing: Investigating the added value of immersion," *IEEE Virtual Reality 2004 Conference*, Chicago, Illinois, March 2004.
- "The COE Kansas City flood control method," 2004 Annual RiverWare User Group Meeting, Boulder, Colorado, March 2004.
- "The added value of immersive visualization," 2004 Drilling Visualization Research Consortium Meeting, Boulder, Colorado, January 2004.
- "Corps of Engineers flood control methods," 2003 Annual RiverWare User Group Meeting, Boulder, Colorado, June 2003.
- "Plotting simulation data," 2001 Annual RiverWare User Group Meeting, Boulder, Colorado, June 2001.
- "Visualization and user interface development for breach, leach, and transport models," Brookhaven National Laboratory SERS Seminar. Upton, NY, May 1994

Honors and Awards

Research
- NREL Distinguished Member of Research Staff (2021-present)
- APS DFD 2020 Gallery of Fluid Motion Award
- NREL 2018 Innovation & Technology Transfer Outstanding New Partnership Award
- NREL 2017 Innovation & Technology Transfer Outstanding Public Information Award
- NREL May 2016 Employee Team of the Month (w/ Nicholas Brunhart-Lupo and Mark Stock)
- NREL FY14 Staff Award – Outstanding Achievement
- NREL 2013 President's Award
- DOE ACSR SciDAC 2011 People's Choice Award
- DOE ACSR SciDAC 2010 Outstanding Achievement in Scientific Visualization
- Advanced Imaging Magazine 2005 Imaging Solutions of the Year
- IEEE Visualization 2004 Visualization Contest Second Place

***Industry** (selected)*
- Raytheon Space and Science Systems CHIP Award
- Raytheon Systems Company Outstanding Achievement Award
- Hughes Space Systems Team Achievement Award

Academic
- New Mexico Tech Regents' Scholarship

Students

Ph.D. Advising

Samantha Molnar, University of Colorado, Aug 2015 - present,
Network Visualization and Analysis

Postdoc Advising

Nicholas Brunhart-Lupo, NREL, Nov 2014 - Oct 2016
Outcome: Hired as NREL Staff Scientist

Roba Binyahib, NREL, Apr 2020 - July 2021
Outcome: Hired as Intel Graphics Engineer

Ph.D. Committee

Nicholas Brunhart-Lupo, Colorado School of Mines, Oct 2014,
Morse decompositions of three-dimensional piecewise constant vector fields

Matthew Whitlock, University of Colorado, November 2021,
Immersive Augmented Reality for Data-Driven Workflows

Summer Students

Sunand Raghupathi (SULI), 2019
Matthew Whitlock (RPP), 2019
Sean Yang, NREL (RPP), 2017
Shane Witter Hicks, NREL (SULI), 2016

Expertise

Languages	C++, R, Python, Lisp, Fortran, IDL, JavaScript, OpenGL Shading Language, CUDA
Libraries	OpenGL, Qt, VTK, ITK, OpenInventor, NetCDF, MPI, d3, X-Windows
Software	VAPOR, ParaView, Avizo, JMP, LaTeX, Unity3D
Areas	Scientific visualization, immersive visualization, human-computer interaction, high-performance scientific computing, object-oriented development, numerical algorithm development, GUI, real-time programming, interactive computer graphics, and simulation

Professional Affiliations

Senior Member	IEEE, IEEE Computer Society
Member	IEEE Visualization and Graphics Technical Committee
Professional Member	Association for Computing Machinery (ACM)
Professional Member	ACM SIGGRAPH, ACM SIGCHI
Member	SIAM
Member	Sigma Xi
Professional Member	American Institute of Aeronautics and Astronautics (AIAA)

Service

Co-chair	EnergyVis 2021, Torino, Italy
Program Chair	DOECGF 2018, Savannah, GA
Site Chair	DOECGF 2017, Golden, CO
Program Committee	Intelligent Data Analysis 2011-2016, SimAUD 2017 - present, CityVis 2020
Steering Committee	DOECGF 2016 - present
Reviewing	IEEE TVCG, IEEE Visualization, LDAV, SIGCHI, IEEE VR, EuroVis, PacificVis, IDA, SimAUD, Journal of Information Science and Engineering
Workshop Participation	Computational Challenges in Energy Systems Integration and Grid Modernization, 2015 DOE Exascale Workshop on Data Analysis, Management, and Visualization, 2011 NREL Workshop on Scientific Data Management and Informatics, 2009
Other	*Mentor*, IEEE VR Doctoral Consortium, 2021 *Coach*, Maple Grove Math Olympiads Team, 2018-2019 *Judge*, CSU Virtual Reality Hackathon, 2016 *Instructor*, Maple Grove Minecraft Club, 2016-2017 *Judge*, Korea Institute of Science and Technology Information (KISTI) Visualization Competition, 2014 *Research Diver*, Pacific Whale Foundation, Summer 1998
Graduate	*Graduate Representative*, 2005-2006 Faculty Search Committee
Undergraduate	*Member*, Solar Car Team, 1993-1994 *Senator*, Student Senate, 1991-1992 *Member*, Student Judiciary Board, 1990-1991

Open-Source Development

CatCost (Catalyst Cost Estimation Tool), catcost.chemcatbio.org

Role: Design

Cost estimation tool designed to reduce the cost uncertainty associated with pre-commercial catalyst materials development.

Surface Phase Explorer, spe.nrel.gov

Role: WebGL Development

Understanding the coadsorption of two species on a surface requires the exploration of phase diagrams. To facilitate exploration this web tool creates interactive and downloadable phase diagrams from ab initio data.

kaleidescope, github.com/NREL/kaleidoscope

Role: Sole Author

An R package developed to visualize PLEXOS scenarios.

VAPOR, www.vapor.ucar.edu

Role: Developer

Contributions: Volume rendering engines, transfer function interface, model parsing and rendering

An interactive 3D visualization and quantitative analysis software suite tailored towards terascale computational fluid dynamics data.

MarsFlight, education.grc.nasa.gov/MarsFlight

Role: Principal Engineer

Contributions: Terrain rendering, subsystems interface, map interface, and front-end configuration & deployment interface

An interactive flight simulator of a Mars airplane concept vehicle, which includes a complete model of the Martian terrain based on MOLA data and rover imagery. The flight simulator is based on the open source FlightGear (www.flightgear.org) project.

iPyMOL, contact dubin@colorado.edu

Role: Principal Engineer

Contributions: Immersive port

An immersive port of the PyMOL (pymol.sourceforge.net) molecular visualization system, adding interactive visualization support for head-tracked, stereoscopic immersive virtual environments.

Other

Certifications	Wilderness EMT / EMT-B Open Water SCUBA Diver
Hobbies	Traditional rock climbing, mogul skiing, cycling, autonomous robotics
Development Portfolio	*(available upon request)*
Security Clearances	*(available upon request)*
References	*(available upon request)*