February 14, 2025

David Borland

132 Fairview Lane
Davidson, NC 28036
(919) 450-7647
borland@renci.org

Main Interests

Designing and implementing algorithms and applications for data visualization and visual analytics. Computer graphics. Visualization environments. Virtual environments. Image processing and analysis. Haptic interfaces.

Education

Ph.D. Computer Science, **University of North Carolina at Chapel Hill** — May 2007
Dissertation: "Flexible Occlusion Rendering for Improved Views of Three-Dimensional Medical Images," under Russell M. Taylor II.

M.S. Computer Science, **University of North Carolina at Chapel Hill** — May 2003

B.S. Computer Science, **Clemson University** — December 2000
General and departmental honors, summa cum laude.

Work Experience

Assistant Director of Analytics & Data Science — Winter 2023-Present
Renaissance Computing Institute (RENCI)
Helping to manage the Analytics and Data Science Group at RENCI. Researching novel data visualization and visual analytics techniques. Developing sophisticated user interfaces to help users understand and work with complex datasets.

Senior Visualization Researcher — Summer 2012-Winter 2023
Renaissance Computing Institute (RENCI)
Researching novel visualization and visual analytics techniques to aid in the interpretation of complex datasets. Developing custom software tools to visualize data for researchers in various fields.

CAVE Manager — Spring 2011-Summer 2012
Event Lab (Universitat de Barcelona)
Managing and developing software for CAVE immersive virtual-reality installation.

Research Fellow — Summer 2010-Summer 2012
Institut d'investigacions Biomèdiques August Pi i Sunyer (IDIBAPS)
Developing virtual reality scenarios and methods for virtual-embodiment applications.

Senior Visualization Researcher — Summer 2007-Summer 2010
Renaissance Computing Institute (RENCI)

Developing custom software tools to visualize data for researchers in various fields. Utilizing and maintaining high-end display devices (stereo display walls, domes, etc.) to aid these visualizations.

Consultant Summer 2007
Siemens Corporate Research
Implementing a GPU-accelerated version of my dissertation work, Flexible Occlusion Rendering (FOR), as part of a licensing agreement between Siemens and UNC. FOR is covered by the two intellectual properties listed below.

Instructor Spring 2006
Visualization in the Sciences (UNC/NC A&T)
Serving as co-instructor of graduate-level course on scientific visualization, cross-listed as UNC Comp 215 and NC A&T CSE 704. Responsible for approximately half of class lectures, as well as creating and grading assignments and projects.

Research Assistant Fall 2001-
Nanoscale Science Research Group (UNC) Spring 2007
Contributing to and creating various systems for scientific visualization, medical imaging, image analysis, and instrument control.

Research Assistant Summer 2000
Virtual Reality Eye-Tracking Project (Clemson)
Creating virtual environments for an eye-tracking project sponsored by NASA.

Co-op Summer 1998,
Siemens Telecom Spring 1999
Writing software tools to manipulate data for the EWSD telephone switch.

Journal Articles

A. Z. Wang, D. Borland, and D. Gotz. **Beyond correlation: incorporating counterfactual guidance to better support exploratory visual analysis**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings of IEEE VIS 2024)*. 31(1)776-786. 2025. Nominated for best paper award

A. Z. Wang, D. Borland, T. Peck, and D. Gotz. **Causal priors and their influence on judgements of causality in visualized data**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings of IEEE VIS 2024)*. 31(1)765-775. 2025.

A. Z. Wang, D. Borland, and D. Gotz. **A framework to improve causal inferences from visualizations using counterfactual operators**. *Information Visualization*. 24(1). 2024.

A. Z. Wang, D. Borland, and D. Gotz. **An empirical study of counterfactual visualization to support visual causal inference**. *Information Visualization*. 23(2). 2024.

M. Fitzgerald, J. Minogue, D. Borland, E. Brunson, and T. Peck. **Which way to go: exploring force arrow placement**. *The Physics Teacher*. 62, 24-28. 2024.

H. O. Masson, D. Borland, J. Reilly, A. Telleria, S. Shrivastava, M. Watson, L. Bustillo, Z. Li, L. Capps, B. P. Kellman, Z. A. King, A. Richelle, N. E. Lewis, and K. Robasky. **Inferring a cell's capabilities from omics data with ImmCellFie**. *STAR Protocols*. 4(1). 2023.

R. H. Barnes, M. L. Golden, D. Borland, R. Heckert, M. Richardson, R. A. Creighton, J. Spang, and G. Kamath. **Computational metrics to quantify video quality in arthroscopic surgery**. *Arthroscopy*. 4(2):e403-e409. 2022.

S. Kaul, D. Borland, N. Cao, and D. Gotz. **Improving visualization interpretation using counterfactuals**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings of IEEE VIS 2021)*. 28(1):998-1008. 2022.

A. Richelle, B. P. Kellman, A. T. Wenzel, A. W. T. Chiang, T. Reagan, J. M. Gutierrez, C. Joshi, S. Li, J. K. Liu, H. Masson, J. Lee, Z. Li, L. Heirendt, C. Trefois, E. F. Juarez, T. Bath, D. Borland, J. P. Mesirov, K. Robasky, and N. E. Lewis. **Model-based assessment of mammalian cell metabolic functionalities using omics data**. *Cell Reports Methods*. 1(3). 2021.

D. Borland, C. M. McCormick, N. K. Patel, O. Krupa, J. T. Mory, A. A. Beltran, T. M. Farah, C. F. Escobar-Tomlienovich, S. S. Olson, M. Kim, G. Wu, and J. L. Stein. **Segmentor: a tool for manual refinement of 3D microscopy annotations**. *BMC Bioinformatics*. 22:260. 2021.

D. Borland, J. Zhang, S. Kaul, and D. Gotz. **Selection-bias-corrected visualization via dynamic reweighting**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings of Visual Analytics Science and Technology 2020)*. 27(2):1481-1491. 2021.

C. Gonzalez-Liencres, L. E. Zapata, G. Iruretagoyena, S. Seinfeld, L. Pérez, J. Arroyo-Palacios, D. Borland, M. Slater, and M. V. Sanchez-Vives. **Being the victim of intimate partner violence in virtual reality: first- versus third-person perspective**. *Frontiers in Psychology*. 11(820). 2020.

D. Borland, W. Wang, J. Zhang, J. Shrestha, and D. Gotz. **Selection bias tracking and detailed subset comparison for high-dimensional data**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings of Visual Analytics Science and Technology 2019)*. 26(1):429-439. 2020.

D. Gotz, J. Zhang, W. Wang, J. Shrestha, and D. Borland. **Visual analysis of high-dimensional event sequence data via dynamic hierarchical aggregation**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings of Visual Analytics Science and Technology 2019)*. 26(1):440-450. 2020.

D. Borland, L. Christopherson, and C. Schmitt. **Ontology-based interactive visualization of patient-generated research questions**. *Applied Clinical Informatics*. 10(03):377-386. 2019.

D. T. Y. Wu, A. T. Chen, J. D. Manning, G. Levy-Fix, U. Backonja, D. Borland, J. J. Caban, D. W. Dowding, H. Hochheiser, V. Kagan, S. Kandaswamy, M. Kumar, A. Nunez, E. Pan, and D. Gotz. **Evaluating visual analytics for health informatics applications: a systematic review from the AMIA VIS Working Group Task Force on Evaluation**. *Journal of the American Medical Informatics Association*. 26(4):314-323. 2019.

D. Gotz, W. Wang, A. T. Chen, and D. Borland. **Visualization model validation via inline replication**. *Information Visualization*. 18(4):405-425. 2019.

D. Borland, H. Yi, G. D. Grant, K. M. Kedziora, H. X. Chao, R. A. Haggerty, J. Kumar, S. C. Wolff, J. G. Cook, and J. E. Purvis. **The Cell Cycle Browser: an interactive tool for visualizing, simulating, and perturbing cell cycle progression**. *Cell Systems*. 7(2):180-184. 2018.

S. Seinfeld, J. Arroyo-Palacios, G. Iruretagoyena, R. Hortensius, L. E. Zapata, D. Borland, B. de Gelder, M. Slater, and M. V. Sanchez-Vives. **Offenders become the victim in virtual reality: impact of changing perspective in domestic violence**. *Scientific Reports*. 8(2692). 2018.

J. Minogue and D. Borland. **Investigating students' ideas about buoyancy and the influence of haptic feedback**. *Journal of Science Education and Technology*. 25:187-202. 2016..

J. Vicory, H. D. Couture, N. E. Thomas, D. Borland, J. S. Marron, J. Woosley, and M. Niethammer. **Appearance normalization of histology slides**. *Computerized Medical Imaging and Graphics*. 43:89-98. 2015.

V. L. West, D. Borland, and W. E. Hammond. **Innovative information visualization of electronic health record data: a systematic review**. *Journal of the American Medical Informatics Association*. 22(2):330-339. 2014.

B. Spanlang, J-M. Normand, D. Borland, K. Kilteni, E. Giannopoulos, A. Pomes, M. Gonzalez-Franco, D. Perez-Marcos, J. Arroyo-Palacios, X. N. Muncunill, and M. Slater. **How to build an embodiment lab: achieving body representation illusions in virtual reality**. *Frontiers in Robotics and AI*. 1:9. 2014.

D. Borland, T. Peck, and M. Slater. **An evaluation of self-avatar eye movement for virtual embodiment**. *IEEE Transactions on Visualization and Computer Graphics (Proceedings IEEE Virtual Reality 2013)*. 19(4):591-596. 2013.

J. Miedema, J. S. Marron, M. Niethammer, D. Borland, J. T. Woosley, J. Coposky, S. Wei, and N. E. Thomas. **Image analysis of melanocytic histology**. *Histopathology*. 61:436-444. 2012.

D. Borland**. Ambient occlusion opacity mapping for visualization of internal molecular structure**. *Journal of WSCG*. 19(1):17-24. 2011.

R. M. Taylor II, J. Jerald, C. VanderKnyff, J. Wendt, D. Borland, D. Marshburn, W. R. Sherman, and M. C. Whitton. **Lessons about virtual environment software systems from 20 years of VE building**. *Presence: Teleoperators and Virtual Environments*. 19(2):162-178. 2010.

P. M. Ryan, L. C. Teague, B. Naydenov, D. Borland, and J. J. Boland. **Emergence and visualization of an interface state during contact formation with a single molecule**. *Physical Review Letters*. 101(9):096801. 2008.

J. R. Fielding, D. Borland, K. H. Lee, J. P. Clarke, E. Wallen, R. Pruthi, and R. M. Taylor II. **Virtual pyeloscopy using volumetric depth peeling**. *Academic Radiology*. 13(6):759-763. 2006.

Conference Papers

Z. Wei, T. Dan, J. Ding, C. McCormick, F. A. Kyere, M. Kim‡, D. Borland, J. L. Stein, and G. Wu. **High Throughput Deep Model of 3D Nucleus Instance Segmentation by Stereo Stitching Contextual Gaps**. *IEEE International Symposium on Biomedical Imaging (ISBI)*. 2023.

H. Yi, C. Bizon, D. Borland, M. Watson, M. Satusky, R. Rittmuller, R. Radwan, R. Srinivasan, and A. Krishnamurthy. **AI tool with active learning for detection of rural roadside safety features**. *Machine Learning on Big Data (MLBD 2021), Special Session of IEEE BigData 2021*. 2021.

K. Qi, D. Borland, E. Brunsen, J. Minogue, and T. Peck. **The impact of prior knowledge on the effectiveness of haptic feedback and visual modalities for teaching forces**. *Proceedings of the 2021 International Conference on Multimodal Interaction (ICMI '21)*. 203-211. 2021.

J. Ma, O. Krupa, M. R. Glass, C. M. McCormick, D. Borland, M. Kim, J. L. Stein, and G. Wu. **3D nucleus instance segmentation for whole-brain microscopy images**. *International Conference on Information Processing in Medical Imaging (IPMI 2021). Lecture Notes in Computer Science*. 12729:504-516. 2021.

V. L. West, D. Borland, D. West, and W. E. Hammond. **An evaluation of machine learning methods and visualization of results to characterize large healthcare document collections**. *Proceedings of the 2015 Annual Meeting of the Decision Sciences Institute*. 2015.

D. Borland, M. Conway, J. Coposky, W. Ginn, and R. Idaszak. **The social computing room: a multi-purpose collaborative visualization environment**. *Proceedings of SPIE-IS&T Electronic Imaging, The Engineering Reality of Virtual Reality 2010*. 7525:97-108. 2010.

M. Macenko, M. Niethammer, J. S. Marron, D. Borland, J. T. Woosley, X. Guan, C. Schmitt, and N. E. Thomas. **A method for normalizing histology slides for quantitative analysis**. *IEEE International Symposium on Biomedical Imaging*. 2009.

D. Borland, J. P. Clarke, J. R. Fielding, and R. M. Taylor II. **Volumetric depth peeling for medical image display**. *Proceedings of SPIE-IS&T Electronic Imaging, Visualization and Data Analysis 2006*. 6060:35-45. 2006.

Workshop Papers

Y. Guo, D. Borland, C. McCormick, J. Stein, G. Wu, and A. Krishnamurthy. **Cell counting with inverse distance kernel and self-supervised learning**. *MICCAI, 1st International Workshop on Medical Optical Imaging and Virtual Microscopy Image Analysis (MOVI)*. Lecture Notes in Computer Science 13578. 2022.

D. Borland, I. Brain, K. Fecho, E. Pfaff, H. Xu, J. Champion, C. Bizon, and D. Gotz. **Enabling longitudinal exploratory analysis of clinical COVID data**. *2021 Workshop on Visual Analytics in Healthcare (VAHC 2021)*. 2021.

K. Qi, D. Borland, N. L. Williams, E. Jackson, J. Minogue, and T. Peck. **Physics education with haptic and visual feedback**. *5th Annual Workshop on K-12+ Embodied Learning through Virtual and Augmented Reality (2020)*. 2020.

D. Borland, L. Christopherson, and C. Schmitt. **Ontology-based interactive visualization of patient-generated research questions**. *2018 Workshop on Visual Analytics in Healthcare (VAHC 2018)*. 2018.

W. Zhao, D. Borland, A. E. Chung, and D. Gotz. **Visual cohort queries for high-dimensional data: a design study**. *2018 Workshop on Visual Analytics in Healthcare (VAHC 2018)*. Accepted for presentation. 2018.

D. Gotz, D. Borland, J. Caban, D. Dowding, B. Fisher, V. Kagan, and D. T. Y. Wu. **Evaluating visual analytics for health informatics applications: a progress report from the AMIA VIS Working Group Task Force on Evaluation**. *2016 Workshop on Visual Analytics in Healthcare (VAHC 2016)*. 2016.

D. Borland, V. L. West, and W. E. Hammond. **Multivariate visualization of system-wide National Health Service data using radial coordinates**. *Proceedings of the 2014 Workshop on Visual Analytics in Healthcare (VAHC 2014)*. 2014.

E. M. Hinz, D. Borland, H. Shah, V. L. West, and W. E. Hammond. **Temporal visualization of diabetes mellitus via hemoglobin A1c levels**. *Proceedings of the 2014 Workshop on Visual Analytics in Healthcare (VAHC 2014)*. 2014.

D. Lynch, D. Borland, R. Kopper, and T. Peck. **Volume visualization on a WIM: design considerations and planned evaluations**. *IEEE Virtual Reality 2014 Workshop on Immersive Volumetric Interaction (WIVI)*. 2014.

V. West, D. Borland, and W. E. Hammond. **Visualization of EHR and health related data for information discovery**. *Proceedings of the 2013 Workshop on Visual Analytics in Healthcare (VAHC 2013)*. 2013.

M. Niethammer, D. Borland, J. S. Marron, J. T. Woosley, and N. E. Thomas. **Appearance normalization of histology slides**. *MICCAI, Workshop on Machine Learning in Medical Imaging*. 2010.

Other Articles

*D. Borland, A. Z. Wang, and D. Gotz. **Using counterfactuals to improve causal inferences in visualizations**. *IEEE Computer Graphics and Applications*. 44(1):95-104. 2024.
* Invited to present at *IEEE VIS 2024*.

D. Borland, W. Wang, and D. Gotz. **Contextual visualization: making the unseen visible to combat bias during visual analysis**. *IEEE Computer Graphics and Applications*. 38(6):17-23. 2018.

D. Borland, T. Chartier, and T. Peck. **Pixar's Linear Algebra**. *IMAGE: The Bulletin of the Linear Algebra Society*. 56:15-20. 2016.

D. Gotz and D. Borland. **Data-driven healthcare: challenges and opportunities for interactive visualization**. *IEEE Computer Graphics and Applications*. 36(3):90-96. 2016.

D. Borland and A. Huber. **Collaboration-specific color map design**. *IEEE Computer Graphics and Applications*. 31(4):7-11. 2011.

D. Borland and R. M. Taylor II. **Rainbow color map (still) considered harmful**. *IEEE Computer Graphics and Applications*. 27(2):14-17. 2007.

D. Borland, J. P. Clarke, and R. M. Taylor II. **Volumetric depth peeling for virtual arthroscopy**. *Electronic Imaging*. 16(2). 2005.

Book Chapters

R. M. Taylor II, D. Borland, F. P. Brooks Jr., M. Falvo, M. Guthold, T. Hudson, K. Jeffay, G. Jones, D. Marshburn, S. J. Papadakis, L.-C. Qin, A. Seeger, F. D. Smith, D. H. Sonnenwald, R. Superfine, S. Washburn, C. Weigle, M. C. Whitton, P. Williams, L. Vicci. and W. Robinett. **Visualization and natural control systems for microscopy**. In C. Johnson and C. Hansen, editors, *Visualization Handbook*. Harcourt Academic Press. pp. 875-900. 2004.

Posters, Presentations, and Demonstrations

A. Z. Wang, D. Borland, and D. Gotz. **Leveraging LLMs to infer causality from visualized data: alignments and deviations from human judgments**. *Poster Abstracts of IEEE VIS 2024*. 2024.

Z. Wang, A. Z. Wang, D. Borland, and D. Gotz. **CausalSynth: an interactive web application for synthetic dataset generation and visualization with user-defined causal relationships**. *Poster Abstracts of IEEE VIS 2024*. 2024.

A. Z. Wang, D. Borland, and D. Gotz. **Countering Simpson's paradox with counterfactuals**. *Poster Abstracts of IEEE VIS 2023*. 2023.

D. Borland and D. Gotz. **Digestable: condensed views of tabular data**. *Poster Abstracts of IEEE VIS 2022*. 2022.

J. Minogue, E. Brunsen, T. Peck, and D. Borland. **Tracing the development of a haptically-enabled science simulation (HESSs) for force and motion**. *2022 NARST Annual International Conference*. 2022.

J. Minogue, E. Brunsen, T. Peck, and D. Borland. **The development and testing of a force & motion simulation**. *Association for Science Teacher Education (ASTE) International Conference*. 2022.

E. Jackson, J. Minogue, K. Qi, T. Peck, and D. Borland. **Exploring user actions while engaged with a haptically-enabled science simulation (HESS) for teaching about buoyancy**. *2021 NARST Annual International Conference*. 2021.

J. Minogue, M. Leen, E. Jackson, K. Qi, T. Peck, and D. Borland. **What's the rule? Exploring pre-service teachers' understandings of buoyancy**. *Association for Science Teacher Education (ASTE) International Conference*. 2021.

D. Gotz, J. Zhang, S. Kaul, G. Bobashev, and D. Borland. **Visual analytics to combat selection bias in retrospective EHR data analyses**. *American Medical Informatics Association (AMIA) Annual Symposium Podium Abstract*. 2020.

K. Qi, D. Borland, N. L. Williams, E. Jackson, J. Minogue, and T. Peck. **The impact of haptic and visual feedback on teaching**. *Proceedings of IEEE Virtual Reality (2020)*. 2020.

J. Minogue, D. Borland, T. Peck, E. Jackson, K. Qi, and N. Williams. **Tracing the development of a haptically-enabled science simulation (HESS) for buoyancy**. *2020 NARST Annual International Conference*. 2020.

J. Zhang, D. Borland, W. Wang, J. Shrestha, and D. Gotz. **Dynamic hierarchical aggregation, selection bias tracking, and detailed subset comparison for high dimensional event sequence data**. *2019 Workshop on Visual Analytics in Healthcare (VAHC 2019)*. 2019.

J. Minogue and D. Borland. **The design and testing of haptically-enabled science simulations**. *2019 AERA Annual Meeting*. 2019.

D. Borland and D. Gotz. **Dual View: multivariate visualization using linked layouts of objects and dimensions**. *Poster Abstracts of IEEE VIS 2018*. 2018.

Y. Zhang, D. Borland, and D. Gotz. **Increasing understanding of survey re-weighting with visualization**. *Poster Abstracts of IEEE VIS 2018*. 2018.

J. Minogue, D. Hunter, D. Borland, and M. Russo. **Upper elementary students' explanations of "why ice melts" and the influence of haptic force feedback**. *2018 NARST Annual International Conference*. 2018.

L. Christopherson, D. Borland, and C. Schmitt. **Using patient-generated research questions to develop an ontology of Crohn's disease**. *10th Annual Conference on the Science of Dissemination and Implementation*. Accepted for presentation. 2017.

P. Owen, C. Bizon, D. Borland, B. Powell, J. Reilly, D. Young, C. Schmitt, and K. Robasky. **Comprehensive framework for automated clinical reporting workflows with integrated genomic analysis via HPC**. *Bio-IT World*. 2017.

D. Borland, V. L. West, and W. E. Hammond. **Multivariate visualization of longitudinal clinical data**. *Proceedings of the IEEE VIS 2016 Workshop on Temporal & Sequential Event Analysis*. 2016.

J. Minogue, D. Borland, M. Russo, and S. T. Chen. **Tracing the development of a haptically-enhanced simulation for teaching phase change**. *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '16)*. 2016.

J. Minogue, D. Borland, M. Russo, S. T. Chen, and Trevor Davis. **Tracing the development of a haptically-enhanced science simulation for matter and intermolecular forces**. *2016 NARST Annual International Conference*. 2016.

D. Borland, E. M. Hinz, L. A. Herhold, V. L. West, and W. E. Hammond. **Path maps: visualization of trajectories in large-scale temporal data**. *Poster Abstracts of IEEE VIS 2015*. 2015.

V. West, D. Borland, D. West, and W. E. Hammond. **Visualization of the health care visualization literature**. *AMIA 2015 Joint Summits on Translational Science*. 2015.

J. Minogue, D. Borland, M. Russo, S. T. Chen, and R. Grady. **Investigating the influence of haptic technology on upper elementary students' reasoning about sinking & floating**. *National Association of Research in Science Teaching (NARST) Annual International Conference*. 2015.

J. Minogue, M. Russo, D. Borland, S. T. Chen, and R. Grady. **Advancing science performance with emerging computer technologies (ASPECT)**. *Association for Science Teacher Education (ASTE) International Conference*. 2015.

H. Shah, D. Borland, E. M. Hinz, V. L. West, and W. E. Hammond. **Demonstration of temporal visualization of diabetes mellitus via hemoglobin A1c levels**. *Proccedings of the 2014 Workshop on Visual Analytics in Healthcare (VAHC 2014)*. 2014.

S. T. Chen, D. Borland, M. Russo, R. Grady, and J. Minogue. **ASPECT: sinking and floating haptics for elementary school students**. *Proceedings of the First ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '14)*. 2014.

S. T. Chen, D. Borland, M. Russo, R. Grady, and J. Minogue. **ASPECT sinking and floating: an interactive playable simulation for teaching buoyancy concepts**. *Proceedings of the First ACM SIGCHI Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '14)*. (Top-Ten Entry, Student Game Design Competition). 2014.

D. Borland, V. West, and W. E. Hammond. **Demonstration of visualization of EHR and health related data for information discovery**. *Proceedings of the 2013 Workshop on Visual Analytics in Healthcare (VAHC 2013)*. 2013. D. Borland. **Integrating head and full-body tracking for embodiment in virtual characters**. *Proceedings IEEE Virtual Reality 2013*. March 2013.

D. Borland. **Integrating head and full-body tracking for embodiment in virtual characters**. *Proceedings IEEE Virtual Reality 2013*. March 2013.

J. Minogue and D. Borland. **Investigating students' ideas about buoyancy and the influence of haptic feedback**. *National Association of Research in Science Teaching (NARST) Annual International Conference*. 2012.

Panels

D. Borland, C. Brewer, K. Moreland, B. Rogowitz, F. Samsel, and M. Stone. **Color mapping in VIS: perspectives on optimal solutions**. *IEEE VIS 2017*. T. M. Rhyne organizer. 2017.

White Papers and Reports

S. Raj, D. Borland, L. Capps, R. Kim, M. Matthew, H. Xu, H. Yi, and K. Robasky. **PDS**. *OSF*. 2020.

D. Borland, R. Idaszak, and T. Carsey. **Getting to know the social computing rooms**. *University of North Carolina at Chapel Hill. RENCI White Paper Series*. 3(4). 2015.

Intellectual Property

D. Borland, J. P. Clarke, and R. M. Taylor II, **Methods, systems, and computer program products for processing three-dimensional image data to render an image from a viewpoint within or beyond an occluding region of the image data**. U.S. Patent 8,150,111, filed March 15, 2006, issued April 3, 2012.

D. Borland, J. P. Clarke, and R. M. Taylor II, **Methods, systems, and computer readable media for flexible occlusion rendering**. U.S. Patent 7,961,187, filed March 20, 2008, issued June 14, 2011.

Invited Presentations

Visualizing information. *The Pines at Davidson Learning in Retirement Series***.** September 26th, 2022.

Contextual visualization methods for large-scale high-dimensional data, with David Gotz. *Duke University Visualization Friday Forum*. January 17, 2020.

Visualizing information. *Duke Center for Health Informatics Short Course*. U.S. Food and Drug Administration. March 16, 2018.

The Cell Cycle Browser: an interactive tool for visualizing, simulating, and perturbing cell cycle progression. *Duke University Visualization Friday Forum*. November 20, 2017.

Visualization of health care data, with Vivian West. *Duke Clinical Research Institute, Clinical Research Informatics Monthly Forum*. August 26, 2015.

Virtual embodiment: implications and applications of self-avatars in immersive virtual environments, with Tabitha Peck. *Living Environments Laboratory, Wisconsin Institute for Discovery at the University of Wisconsin-Madison*. May 13, 2014.

Visualization of health informatics data. *Duke University Visualization Friday Forum*. April 4, 2014.

Virtual embodiment: implications and applications of self-avatars in immersive virtual environments, with Tabitha Peck. *Duke University Visualization Friday Forum*. October 12, 2012.

Understanding game engines and game development, with M. Conway and E. Knisley. *UNC-Chapel Hill Games4Learning*. September 19, 2008.

Flexible occlusion rendering for improved views of three-dimensional medical images. *UNC-Chapel Hill Biomedical Research Imaging Center (BRIC) Research Symposium*. May 10, 2007.

Professional Activities

Visual Analytics in Healthcare (VAHC). Organizer and program committee member. 2017-present.

American Medical Informatics Association (AMIA) Visual Analytics Working Group (VIS WG) Task Force on Evaluation. Member. 2016-2019.

Triangle Visualization Group. Organizer. 2016-2020.

International Conference on Information Visualization Theory and Applications (IVAPP). Program committee member. 2014-present.

Department of Energy (DOE) SBIR/STTR Phase II, Scientific Visualization and Data Understanding. Review panel member. 2010.

Hands-on visualization workshop, with R. M. Taylor II. *DOD Minority-Serving Institutions CSE-HPC Faculty Training Workshop*, NCA&T University. July 2006.

Honors and Awards

Honorable Mention for Best Paper: For "Beyond correlation: incorporating counterfactual guidance to better support exploratory visual analysis." (IEEE VIS 2024)
Award of Excellence: Internal award for work on Spectacular Justice project, described below. (RENCI)
Extra Mile Award: Internal award for work on Spectacular Justice project, described below. (RENCI)
TA of the Year Award: Honorable mention. For work as Visualization in the Sciences instructor. (UNC)
SensAble Developer Challenge: Honorable mention. For HapticCell program, described below. (UNC)
Dupont Project Award. For outstanding work in computer science. (Clemson)
Vice President: Upsilon Pi Epsilon, national computer science honors society. (Clemson)

Programming Skills

JavaScript, D3, React, vtkjs, Unity, C/C++, OpenGL, VTK, ITK, Qt, GLSL, Matlab, Java, Python, R

Systems Built

Ninjatō: Web-based tool for collaborative annotation of nuclei from microscopy images.

ImmCellfie Dashboard: Web-based portal to enable the analysis and visualization of gene expression data using a cellular function inference model.

Digestable: Visualization tool for summarizing large tabular datasets.

Roadway Hazard Finder: Web-based tool for annotating roadway hazards from videolog data.

Cadence: Visual analytics platform for event sequence analysis.

Segmentor: Segmentation tool for 3D tissue cleared microscopy images of nuclei.

PERCEPT: Series of interactive simulations for learning about science concepts using a haptic force-feedback device, developed using Unity.

Cell Tracker: Interactive web-based tool for tracking and segmenting cells from live-cell microscopy images.

Cell Cycle Browser: Interactive web-based tool for visualizing, and perturbing simulations of cell cycle progression.

ASPECT: Series of interactive simulations for learning about science concepts using a haptic force-feedback device, developed using Unity.

Carnac: A prototype genomics clinical decision support user interface developed using D3.

Radial Coordinates: A multivariate visualization tool built using D3.

Cascade: An interactive exhibit for the Morehead Planetarium that enables users to interact with a water simulation using cast shadows.

vrpn_Qt: A library, now incorporated into the VRPN source code, for mapping GUI widgets to VRPN button and analog devices, enabling remote control of applications via a Qt GUI.

Visualize Particulate Matter (VPM): A tool enabling researchers at the Institute for the Environment at UNC-Chapel Hill to inspect simulated particle distributions and compare with observed data.

Collage: A tool for viewing and interacting with multiple images and videos in the visualization facilities at RENCI.

vtkMultiChannel: Extensions to the Visualization ToolKit (VTK) to enable rendering in the visualization facilities at RENCI, including a 15 ft diameter immersive dome and an ultra-high-resolution stereo display.

vtkInteractionDevice: Extensions to the Visualization ToolKit (VTK) to enable the use of peripheral interaction devices using the Virtual Reality Peripheral Network (VRPN) as well as multitouch devices developed at RENCI.

Voluminous: Tool for viewing slices and surface of atomic charge density data in an immersive dome display and in stereoscopic 3D.

PixelViewer: Tool for viewing pixel distributions from stained biopsy slides in stereoscopic 3D.

Spectacular Justice: Multi-user immersive multimedia art installation utilizing the 360-degree immersive Social Computing Room at RENCI created in collaboration with Joyce Rudinsky, Associate Professor in Communication Studies at UNC-Chapel Hill.

TeleImmersion: Prototype stereo teleconferencing system that uses two HD video feeds to enable stereoscopic 3D viewing of collaborators. Also implements shared control of stereoscopic 3D objects rendered "between" the users and their collaborators.

MatchMaker: Program for the display of job flow data on the Open Science Grid computational infrastructure.

Innerspace: Program for the display of three-dimensional reconstructions of MR and CT images. Improves upon standard volume rendering by enabling the user to see through occluding regions that are not of interest from the current viewpoint, making possible views of anatomy from positions that are not accessible using real arthroscopy or standard volume-rendering techniques.

FORViewer: A GPU-accelerated version of Flexible Occlusion Rendering and associated user interface implemented at Siemens Corporate Research.

StretchArmstrong and MasterShake: Graphic and haptic interactives developed with the Museum of Life and Science in Durham, NC to aid in understanding nanoscale materials and forces.

aMaze: A maze game for blind children designed to increase spatial awareness through a haptic force-feedback device.

HapticCell: Educational software for learning about cells using haptic force-feedback devices, using the OpenHL haptics library from SensAble. Won SensAble Developer Challenge Honorable Mention, awarded at SIGGRAPH 2005.

Digital Micrograph Analysis Tools: Created tools within Gatan's Digital Micrograph framework for the analysis of transmission electron microscope (TEM) diffraction patterns and the transmission of TEM images over a network connection.

TEM Simulator: Implemented a system for the simulation of transmission electron microscope (TEM) images on consumer graphics hardware, enabling an orders-of-magnitude speedup over previous image simulation techniques. Enables the comparison of experimental data with simulated images of hypothesized models in real time.

AFM/Flourescence Simulator: Developed techniques for creating real-time simulations of atomic force microscope (AFM) and flourescence microscope images on consumer graphics hardware for comparison with experimental data.

Blur Buffer: A technique for performing per-pixel blurring effects, such as depth-of-field, on consumer graphics hardware.

Anisotropic Diffusion on Graphics Hardware: A technique for performing edge-preserving anisotropic diffusion on consumer graphics hardware.

CDView: Tool for viewing and analyzing molecular charge density data. Employs a novel visualization technique that modulates opacity based on reaction-diffusion patterns solved directly on isosurfaces.

MEMS Controller: A system for controlling micro-electromechanical systems (MEMS) using a SensAble Phantom as an input device.

TAMS Curvature System: A system for determining the curvature of thermally-actuated mechanical systems (TAMS) from scanning electron microscope (SEM) images by displaying projective textures on user-controlled models.

Distributed Xinu: Implemented the microkernel of a distributed operating system based on the Xinu framework, with a distributed terminal service on top of the microkernel.

Visualizations in Publications

Broadening access to the power of computational biology. *CASC 2023 Brochure. 2023*.

Drawing on the power of the crowd for IBD insights. *CASC 2020 Brochure*. 2020.

Catalyzing advances in solar technology. *CASC 2015 Brochure*. 2015.

Seeing particles with VPM. *International Science Grid This Week*. June 9, 2010.

Cochlear implant simulation. *CASC 2010 Brochure*. 2010.

Follow the flow. *American Scientist*. July-August 2009.

Let's get visual. *Endeavors*. Winter 2009.

A visual depiction of the influence of relativistic effects on the electronic structure of uranium. *TeraGrid '08* Visualization Gallery. 2008.

Matchmaking on the grid. *International Science Grid This Week* Image of the Week, June 18, 2008.