

Dave Kelbe

Curriculum vitae

Education

July 2015 **PhD Imaging Science**, *Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology (RIT)*, Rochester, NY, USA, GPA: 3.86/4.00.

Imaging science combines insight from fundamental science with an in-depth technical understanding of sensing systems to deliver practical solutions to real-world problems. A quantitative, first-principles, systems-level framework provides highly-transferrable skills for domain leadership across various fields relying on image and signal understanding.

Concentrations: **Remote Sensing** and **3D Imaging**

Thesis: *Operationalizing forest structure assessment using terrestrial laser scanning.*

I advanced low-cost mobile laser scanning technology for ecological assessment. I developed algorithms to extract spatially explicit, geo-referenced, biophysical ground truth parameters in the forest environment, with applications to improved understanding of the phenomenology of airborne hyperspectral and lidar systems. Outputs are being used via data fusion to provide antecedent science data on the assessment of vegetation structure via spectroscopy for NASA's HypSIIRI mission, as well as to support the National Ecological Observatory Network's long-term environmental monitoring initiatives.

Press: Clabby, C. (2015, January - February). Fly-By Forestry Takes Off. *American Scientist*, 103 (1), p. 23. DOI: 10.1511/2015.112.23.

Honors: National Science Foundation Graduate Research Fellow, United States Geospatial Intelligence Foundation Doctoral Scholar, College of Science Commencement Speaker.

May 2010 **B.S. Imaging Science**, *Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology (RIT)*, Rochester, NY, USA, GPA: 3.93/4.00 with highest honors. Honors Program.

Fall 2008 **Study Abroad**, *Otago University*, Dunedin, New Zealand.
Coursework:

Experience

2016–present **Postdoctoral Research Scientist**, *Geographic Information Science and Technology Group, Oak Ridge National Laboratory*, Oak Ridge, TN, USA.

- Integral team member for the development of the next-generation image processing pipeline for a major government sponsor. I lead the development of a 3D reconstruction capability from multi-view airborne imagery. Integration of “image chain” principles to improve image quality and image exploitation algorithms from remote sensing platforms. Work closely with software engineering team to accelerate high performance computing (HPC) software and hardware solutions for real-time image-based navigation from unmanned aerial systems (UAS). Provide domain expertise and key technical contributions on collaborative projects across the lab to solve global challenges in energy, environment, and security.

- 2012–present **Independent Consultant**, for *various international projects concerning the spectral imaging of historic artifacts*, Rochester, NY, USA.
- As a technical consultant, I advised spectral imaging hardware configuration, calibration, and exploitation to recover erased writing from ancient, recycled manuscripts. I developed statistical image processing techniques to elucidate erased inks based on statistical machine learning, and streamlined products for high throughput. For management of large data volumes, I automated metadata ingestion procedures for storage in a digital archive. Continued cross-discipline, cross-language collaboration and communication with both scientists and non-technical Byzantine scholars has solidified core teamwork skills. Moreover, I provided consistent and punctual fulfillment of deliverables while maintaining competitive PhD research.
- Press:** Schrope, M. (2012, September 9). Raiders of the Lost Text. *The Washington Post*, pp. 12-18
 Quain, J. (2012, July/August). Chasing the Invisible. *American Photography*, pp. 50-53, 74, 76
- 2011–present **Graduate Research Assistant**, *Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology*, Rochester, NY, USA.
- Extensive involvement in field campaigns to support hyperspectral data acquisition with ground-based reference data, both nationally and internationally. This has provided practical experience in operation and application of ground instrumentation, sensor calibration, and campaign planning/organization. As the team leader of multiple campaigns, I developed and documented protocols for field data collection and subsequent data analysis, and distributed these deliverables to collaborating parties.
- 2010–2011 **Graduate Teaching Assistant**, *Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology*, Rochester, NY, USA.
- As teaching assistant for *Innovative Freshman Experience*, I led a multidisciplinary team of students through the year-long process of designing, developing, and testing a reflectance transformation imaging (RTI) device. With significant hardware and software components, complex integration, budgetary restrictions, external critical design reviews, and fast-paced deadlines, I gained crucial experience in both the engineering and exploitation of a sensing system over the product life-cycle, and the management/mentorship of a multidisciplinary student team.
- 2007–2010 **Undergraduate Research Assistant**, *Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology*, Rochester, NY, USA.
- My first appointment involved researching improvements for quantitative anomaly detection using hyperspectral imagery. My second focus involved collecting remote sensing truth data for ecological applications. I planned and led an international field campaign in collaboration with the Council for Scientific and Industrial Research, South Africa, to measure ground truth data for calibration/validation of hyperspectral imagery and lidar data.
- 2008 **Research Assistant (Volunteer)**, *Otago University*, Dunedin, New Zealand.
- Contributed to the Global Land Ice Measurements from Space (GLIMS) database by classifying and segmenting glaciers from ASTER satellite imagery.
- 2008 **Photo Correspondent**, *National Geographic Glimpse Magazine*, Dunedin, New Zealand.
- Documented cross-cultural life, for publication in print and online.
 - Gained experience in rural and remote field work.

Publications

Refereed Journal Articles

1. **Kelbe, D.**, van Aardt, J., Romanczyk, P., and van Leeuwen, M. Graph-based co-registration of a network of forest terrestrial laser scans. *Remote Sensing of Environment*. In review.
2. **Kelbe, D.**, van Aardt, J., Romanczyk, P., and van Leeuwen, M. (2016). Marker-free registration of forest terrestrial laser scanner data pairs with embedded confidence metrics. *IEEE Transactions on Geoscience and Remote Sensing* (99). DOI: 10.1109/TGRS.2016.2539219.
3. Yao, W., van Leeuwen, M., Romanczyk, P., **Kelbe, D.**, and van Aardt, J. (2016). Towards an improved LAI collection protocol via simulated and field-based PAR sensing. *Sensors* **in press**.
4. **Kelbe, D.**, van Aardt, J., Romanczyk, P., Cawse-Nicholson, K., and van Leeuwen, M. (2015). Single-scan stem reconstruction using low-resolution terrestrial laser scanner data. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* **8** (7). DOI: 10.1109/JSTARS.2015.2416001.
5. Romanczyk, P., van Aardt, J., Cawse-Nicholson, K., **Kelbe, D.**, McGlinchy, J., and Krause, K. (2013). Assessing the Impact of Broadleaf Tree Structure on Airborne Full-waveform Small-footprint Lidar Signals Through Simulation. *Canadian Journal of Remote Sensing* **39** (S1), S60–S72. DOI: 10.5589/m13-015.

Three articles in preparation are not reported.

Refereed Conference Proceedings

1. Paris, C., **Kelbe, D.**, van Aardt, J., and Bruzzone, L. (2015). A precise characterization of the 3D structure of tree crowns based on the fusion of Airborne and Terrestrial LiDAR data. In: *Proceedings of IGARSS*. Milan, Italy.
2. Yao, W., van Aardt, J., Romanczyk, P., Brown, S., and **Kelbe, D.** (2015). Towards robust forest leaf area index assessment using an imaging spectroscopy simulation approach. In: *Proceedings of IGARSS*. Milan, Italy.
3. Yao, W., van Aardt, J., Romanczyk, P., **Kelbe, D.**, and van Leeuwen, M. (2015). Assessing the impact of sub-pixel vegetation structure on imaging spectroscopy via simulation. In: *Proceedings of SPIE Defense + Security*. International Society for Optics and Photonics. Baltimore, MD, USA, pp.94721K–94721K. DOI: 10.1117/12.2176992.
4. **Kelbe, D.**, Romanczyk, P., van Aardt, J., and Cawse-Nicholson, K. (2014). Comparison of Diameter Retrieval Algorithms for Single-scan Terrestrial Lidar. In: *Proceedings of IGARSS*. Quebec, QC, Canada.
5. Paynter, I., Li, Z., Schaaf, C., Strahler, A., Saenz, E., Peri, F., Howe, G., Hewawasam, K., Martel, J., Douglas, E., Chakrabarti, S., Cook, T., Wang, Z., Liu, Y., Rouhani, S., Erb, A., Schaefer, M., Newnham, G., Jupp, D., van Aardt, J., **Kelbe, D.**, Romanczyk, P., Cawse-Nicholson, K., Faulring, J., Kampe, T., Krause, K., Leisso, N., Armston, J., Phinn, S., Muir, J., and Culvenor, D. (2014). Augmenting Full-Waveform Dual-Augmenting Full-waveform Dual-Wavelength Echidna® Lidar (DWEL) With Highly-portable Canopy Biomass Lidar (CBL) For Forestry Assessment And Satellite Validation. In: *Proceedings of IGARSS*. Quebec, QC, Canada.
6. van Aardt, J., **Kelbe, D.**, Romanczyk, P., Cawse-Nicholson, K., Krause, K., Ramond, T., and Kampe, T. (2014). Towards Extraction Of Vegetation Biophysical Parameters From The Neon Airborne Observation Platform (AOP) Waveform Lidar. In: *Proceedings of IGARSS*. Quebec, QC, Canada.

7. Cawse-Nicholson, K., van Aardt, J., **Kelbe, D.**, Romanczyk, P., Kampe, T., and Krause, K. (2013). On the Scalability of Spectral Leaf Area Index Metrics. In: *Proceedings of ASPRS*. Baltimore, MD, USA.
8. Cawse-Nicholson, K., van Aardt, J., Romanczyk, P., **Kelbe, D.**, Krause, K., and Kampe, T. (2013). A Study of Energy Attenuation Due to Forest Canopy in Small-footprint Waveform Lidar Signals. In: *Proceedings of ASPRS*. Baltimore, MD, USA.
9. Easton, R. L. and **Kelbe, D.** (2013). Statistical Processing of Spectral Imagery to Recover Writings from Erased or Damaged Manuscripts (**invited**). In: *International Conference on Natural Sciences and Technology in Manuscript Analysis*. Hamburg, Germany.
10. Kato, A., Morgenroth, J., **Kelbe, D.**, Gomez, C., and van Aardt, J. (2013). Ground truth measurement of trees using terrestrial laser for satellite remote sensing. In: *Geoscience and Remote Sensing Symposium (IGARSS), 2013 IEEE International*. IEEE, pp.2106–2109.
11. **Kelbe, D.** (2013). Supervised processing techniques: Independent component analysis (ICA). In: *The Sinai Palimpsests Project Scholars and Scientists*. Vienna, Austria.
12. **Kelbe, D.**, Romanczyk, P., van Aardt, J., and Cawse-Nicholson, K. (2013). Reconstruction of 3D Tree Stem Models From Low-cost Terrestrial Laser Scanner Data. In: *Proceedings of SPIE 8731, Laser Radar Technology and Applications XVIII*. Baltimore, MD, USA, pp.873106. DOI: 10.1117/12.2015963.
13. Romanczyk, P., van Aardt, J., **Kelbe, D.**, Cawse-Nicholson, K., and Ramond, T. (2013). The Effect of Positioning Error on the Repeatability of Small-Footprint Waveform Lidar Signals. In: *Proceedings of Silvilaser*. Beijing, China, pp.202–209.
14. **Kelbe, D.**, Romanczyk, P., van Aardt, J., Cawse-Nicholson, K., and Krause, K. (2012). Automatic Extraction of Tree Stem Models From Single Terrestrial Lidar Scans in Structurally Heterogeneous Forest Environments. In: *Proceedings of Silvilaser*. Vancouver, Canada, pp.54–61.
15. Romanczyk, P., **Kelbe, D.**, van Aardt, J., Cawse-Nicholson, K., McGlinchy, J., and Krause, K. (2012). Assessing the Impact of Broadleaf Tree Structure on Airborne Full-waveform Small-footprint LiDAR Signals. In: *Proceedings of Silvilaser*. Vancouver, Canada, pp.271–278. **Best student paper**.

Conference Presentations (No Proceedings)

1. **Kelbe, D.** (2014). Reconstruction of 3D tree stem models from low-cost terrestrial laser scanner data. In: *Central New York ASPRS Annual Meeting*. Pittsford, NY, USA.
2. Easton, R. L. and **Kelbe, D.** (2013). Imaging Technologies and the impending new golden age of digital humanities (**invited**). In: *Rochester Academy of Science Fall Paper Session*. Rochester, NY.
3. Romanczyk, P., van Aardt, J., Cawse-Nicholson, K., **Kelbe, D.**, Strahler, A., Schaaf, C., Krause, K., and Ramond, T. (2013). Attenuation Due to Foliar Geometry Interactions in Waveform Lidar Signals. In: *AGU Fall Meeting*. San Francisco, CA, USA.
4. Schaaf, C., Strahler, A., van Aardt, J., Chakrabarti, S., Li, Z., Wang, Z., Yang, X., Saenz, E., Paynter, I., Erb, A., Yang, Y., Liu, Y., Rouhani, S., Peri, F., Kim, J., Cawse-Nicholson, K., Romanczyk, P., **Kelbe, D.**, Faulring, J., Nicholson, T., Douglas, E., Martel, J., Howe, G., Hewawasam, K., Cook, T., Culvenor, D., Newnham, G., Jupp, D., Lovell, J., Krause, K., Leisso, N., Kampe, T., and Meier, C. (2013). Terrestrial LiDAR Measures of Forest Structure. In: *Silvilaser*. Beijing, China.

Conference Posters

1. Cawse-Nicholson, K., van Aardt, J., Romanczyk, P., **Kelbe, D.**, Bandyopadhyay, M., Yao, W., Krause, K., and Kampe, T. (2013). The Effect of Lidar Point Density on LAI Estimation. In: *AGU Fall Meeting*. San Francisco, CA, USA.

2. **Kelbe, D.**, Romanczyk, P., van Aardt, J., and Cawse-Nicholson, K. (2013). Automatic Marker-free Registration of Terrestrial Laser Scanner Data for Forestry Applications. In: *Silvilaser*. Beijing, China.
3. **Paynter, I.**, Saenz, E., Peri, F., Schaaf, C., Wang, Z., Erb, A., Yang, Y., Rouhani, S., Liu, Y., Yang, X., Chen, R., Oktay, S., Gontz, A., Douglas, E., Kim, J., Sun, Q., Strahler, A., Li, Z., van Aardt, J., **Kelbe, D.**, Romanczyk, P., and Cawse-Nicholson, K. (2013). Coastal Applications of the Canopy Biomass Lidar (CBL). In: *AGU Fall Meeting*. San Francisco, CA, USA.
4. **Schaaf, C.**, Paynter, I., Saenz, E., Peri, F., Wang, Z., Erb, A., Yang, X., Strahler, A., Li, Z., van Aardt, J., **Kelbe, D.**, Romanczyk, P., Cawse-Nicholson, K., Krause, K., Leisso, N., Kampe, T., Meier, C., Ritz, C., Chakrabarti, S., Cook, T., Howe, G., Martel, J., Hewawasam, K., Douglas, E., Newnham, G., Schaefer, M., Armston, J., Muir, J., Tindall, D., and Phinn, S. (2013). Canopy Biomass Lidar (CBL) Acquisitions at NEON and TERN Forest Sites. In: *AGU Fall Meeting*. San Francisco, CA, USA.

Advising

Technical Mentorship

- 2015–2016 **Cynthia M. Scheuermann, MSc Biology student, Virginia Commonwealth University (VCU)**, Integration of LiDAR metrics to understand carbon (C) cycling trends over decadal timescales: A study at the University of Michigan Biological Station
- 2015–2016 **Damianos Kasotakis, PhD student, University of Athens, Greece**, Acceleration of spectral image processing to recover erased writing from ancient Greek documents.
- 2015–2016 **Giulia Rosetto, PhD student, Byzantine Studies, University of Vienna, Austria**, Utilization of spectral imaging and image processing for paleography applications.
- 2015–2016 **Tamuna Gegia, PhD student, Tbilisi State University, Republic of Georgia**, Integration of spectral image processing to recover erased writing in the Georgian language.

Independent Study

- 2015–2016 **Kevin Sacca**, Assessing bird-song acoustics across a structural gradient using LiDAR: A case study in Hawaii.

Senior Thesis Projects

- 2013–2014 **Ashley Miller**, “Canopy Segmentation using Airborne LiDAR.”
- 2013–2014 **Jonathan Rowe**, “Ground Classification and Below Ground Response Assessment of Forested Regions using Full-Waveform LiDAR.”
- 2012–2013 **Colin Axel**, “Fusion of Terrestrial LiDAR Point Clouds with Color Imagery.”
- 2011–2012 **Kevin Bloechl**, “Automatic Registration of Ground-Based LiDAR Point Clouds of Forested Areas.”
- 2011–2012 **Linnea Tullson**, “Extraction and Quantification of Trees from Ground-based LiDAR Point Clouds.”
- 2011–2012 **Thomas Yang**, “Extraction and Modeling of Planar Surfaces from Ground-Based LiDAR Point Clouds.”

Service

- 2016-present Actively developing synergistic relationships (e.g., job recruiting, mentoring, internships, subcontracting) between Oak Ridge National Laboratory and RIT.
- 2015 Presenter at the Toyota-RIT Applied Math Initiative (TAMI) to serve the needs of high-school mathematics teachers, Rochester, NY, USA.
- 2010–2015 **Minister of hospitality, The Dimitri House**, Rochester, NY, USA.

- Stay overnight and cook breakfast for homeless men at an emergency men's winter shelter.
- 2013–2015 **Community group leader**, *Northridge Church*, Rochester, NY, USA.
- 2012–2014 **Tutor**, *Mary's Place Outreach*, Rochester, NY, USA.
 - Role model, tutor, and friend of refugee children.
 - Organized field trip to Imagine RIT Innovation and Creativity Festival.
- 2009, -11, -14 **Volunteer teacher**, *St. Matthew's Orphanage Center*, Pyin Oo Lwin, Myanmar.
 - Promote academic proficiency and excitement in science by developing and teaching engaging science experiments to grade 11 students.
- 2013–2014 **Committee member**, Bruce R. James Distinguished Public Service Award, *Rochester Institute of Technology*.
 - 2012 Recipient of the RIT Bruce R. James Distinguished Public Service Award.
 - 2012 Press: Sorensen, K. (2012-13, Winter) Graduate Students Making a Difference, *RIT University Magazine*, pp. 18-23.
- 2009–2010 **Vice president**, *IS&T Student Chapter/Imaging Science Club*, Rochester, NY, USA.

Honors And Awards

- 2016 **Third Place**, 2016 IEEE GRSS International Data Fusion Contest.
- 2016 **Doctoral Dissertation of the Year**, Rochester Institute of Technology.
- 2016 **Finalist, Alvin Weinberg Distinguished Fellowship**, Oak Ridge National Laboratory.
- 2015 **Graduate Student Delegate (Commencement Speaker)**, RIT College of Science.
- 2012–2015 **Graduate Research Fellowship**, National Science Foundation.
- 2012 **Doctoral Scholarship**, United States Geospatial Intelligence Foundation.
- 2012 **Bruce R. James Distinguished Public Service Award**, RIT.
- 2010 **Outstanding Undergraduate Scholar**, RIT.
- 2010 **John Wiley Jones Outstanding Undergraduate Researcher**, RIT College of Science.
- 2009 **Jerry Hughes Memorial Scholarship**, RIT Center for Imaging Science.

References

Dr. Jan van Aardt

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