Daniel Hellfeld, Ph.D.

CONTACT

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SUMMARY

Applied research scientist leveraging computer vision and machine learning techniques to solve complex inversion problems. 5+ years experience in developing, testing and deploying software for anomaly detection, image reconstruction and real-time 3D mapping.

EDUCATION

Doctor of Philosophy (Ph.D.), Nuclear Engineering (4.0/4.0) **Jul 2019**
University of California, Berkeley *Berkeley, CA*
- Thesis: "Free-moving Omnidirectional 3D Gamma-ray Imaging and Localization".
- Advisor: Prof. Kai Vetter.

Master of Science (M.S.), Nuclear Engineering (4.0/4.0) **May 2015**
Texas A&M University *College Station, TX*
- Thesis: "Feasibility of Remote Nuclear Reactor Antineutrino Directionality via Elastic Electron Scattering in the WATer CHerenkov Monitor of ANtineutrinos (WATCHMAN)".
- Advisor: Prof. Craig Marianno.

Bachelor of Science (B.S.), Physics (3.89/4.0) **Jun 2013**
University of California, Santa Barbara *Santa Barbara, CA*

RESEARCH EXPERIENCE

Senior Scientific Engineering Associate **Aug 2019 - Present**
Applied Nuclear Physics Group, Lawrence Berkeley National Laboratory *Berkeley, CA*
- Real-time quantitative 3D mapping with contextual and radiological data streams.
- 3D object detection and tracking in LiDAR point clouds using sparse convolution neural networks for improved radiological source detection and attribution.
- Anomaly detection algorithm development for a city-scale network of multi-sensor systems.

Research Fellow **Nov 2014 - Jul 2019**
Nuclear Science and Security Consortium, UC Berkeley *Berkeley, CA*
- Modeling and imaging algorithm development for free-moving multi-platform (e.g., hand-held, ground robot/vehicles, UAS) gamma-ray imagers.
- Fusion of contextual sensors (e.g., LiDAR, RGBD camera, IMU) and computer vision techniques (e.g., SLAM, photogrammetry) with gamma-ray image reconstruction.
- Experimental demonstration of omnidirectional 3D active coded mask imaging in real-time.

Physics Intern **Jun - Aug 2015/2014**
Rare Event Detection Group, Lawrence Livermore National Laboratory *Livermore, CA*
- Monte Carlo simulations and statistical data analysis for a proposed antineutrino detector.
- Study on the feasibility of remote clandestine nuclear reactor directionality.
- Investigation of electron scattering background sources in water and the impact of overburden, fiducial volume, and radon contamination on directionality.

TEACHING EXPERIENCE

Lecturer **Jan - May / Sep - Nov 2018**
Department of Nuclear Engineering, UC Berkeley *Berkeley, CA*
- Undergraduate radiation detection (NE 104): semiconductor and scintillator detector operation, manufacturing, signal generation, readout techniques, applications and limitations.
- Undergraduate imaging (NE 107): X-ray detection, image formation, computed tomography, and phase contrast imaging.

MENTORSHIP EXPERIENCE

Kalie Knecht, *graduate* **Sep 2019 - Present**
Department of Nuclear Engineering, UC Berkeley
- 3D image reconstruction and scene data fusion with a free-moving gamma-ray detector and auxiliary contextual sensor package.
- Data analysis for recent measurement campaign at the Fukushima Daiichi NPP, Japan.

David Raji, *undergraduate* **Jun - Aug 2018/2017**
Department of Nuclear Engineering, Georgia Institute of Technology
- Sensitivity-weighted adaptive voxelization for free-moving imaging.
- Real-time probabilistic tri-state point cloud occupancy with ray-casting.

SCIENTIFIC COMPUTING SKILLS

Languages:	Python, C++, bash
Data/Statistical Analysis:	ROOT, R
Machine Learning:	PyTorch, TensorFlow
Build Systems:	make, CMake, ninja, catkin
Operating Systems:	macOS, Linux, Windows
Resource Management:	SLURM
Robotics:	ROS
GPU Programming:	OpenCL, OpenGL, CUDA
Databases:	HDF5, SQL
CI/CD:	TravisCI, Docker
Documentation:	Doxygen, Sphinx
Markup:	Markdown, XML, HTML
Version Control:	git
Other Software:	LaTeX

AWARDS

R&D 100 Award Winner, R&D World Magazine, WTWH Media	**Nov 2019**
Best Paper Award, UC Berkeley NE Dept.	**Dec 2018**
Runner-up Student Paper Competition, IEEE NSS-MIC	**Oct 2017**
Best Oral Presentation, University Program Review Meeting	**Jun 2017**
Best Poster Award, INMM Annual Meeting	**Jul 2015**
Nuclear Science and Security Consortium Fellowship, UC Berkeley	**Nov 2014**
Graduate Enhancement Fellowship, Texas A&M University	**Aug 2013**
Highest Academic Honor Award, UC Santa Barbara, Physics Dept.	**May 2013**
Highest Honors, UC Santa Barbara	**May 2013**

PUBLICATIONS, PROCEEDINGS & PAPERS

[1] J. R. Vavrek, **D. Hellfeld**, M. S. Bandstra, V. Negut, K. Meehan, W. J. Vanderlip, J. W. Cates, R. Pavlovsky, B. J. Quiter, R. J. Cooper, and T. H. Y. Joshi, "Reconstructing the Position and Intensity of Multiple Gamma-Ray Point Sources with a Sparse Parametric Algorithm," *IEEE Trans. Nucl. Sci. (in press)*, Sep. 2020.

[2] **D. Hellfeld**, P. Barton, A. Haefner, D. Gunter, L. Mihailescu, and K. Vetter, "Real-time Free-moving Active Coded Mask 3D Gamma-ray Imaging," *IEEE Trans. Nucl. Sci.* , vol. 66, no. 10, pp. 2252–2260, Oct. 2019.

[3] **D. Hellfeld**, T. H. Y. Joshi, M. S. Bandstra, R. J. Cooper, B. J. Quiter, and K. Vetter, "Gamma-Ray Point-Source Localization and Sparse Image Reconstruction using Poisson Likelihood," *IEEE Trans. Nucl. Sci.*, vol. 66, no. 9, pp. 2088–2099, Jul. 2019.

[4] **D. Hellfeld**, "Free-moving Omnidirectional 3D Gamma-ray Imaging and Localization," Ph.D. dissertation, University of California, Berkeley, Jul. 2019.

[5] K. Vetter, A. Haefner, R. Barnowski, P. Barton, **D. Hellfeld**, T. H. Y. Joshi, R. Pavlovsky, Y. Sanada, Y. Shikaze, and T. Torii, "3D Radiation Mapping and Data Fusion for Environmental Remediation and Cleanup," *in Proc. Waste Management Symp.*, Phoenix, AZ, Mar. 2018.

[6] **D. Hellfeld**, P. Barton, D. Gunter, L. Mihailescu, and K. Vetter, "A Spherical Active Coded Aperture for 4π Gamma-ray Imaging," *IEEE Trans. Nucl. Sci.*, vol. 64, no. 11, pp. 2837–2842, Nov. 2017.

[7] **D. Hellfeld**, P. Barton, A. Haefner, D. Gunter, L. Mihailescu, and K. Vetter, "Omnidirectional 3D Gamma-ray Imaging with a Free-moving Spherical Active Coded Aperture," *in Proc. IEEE NSS-MIC*, Atlanta, GA, Oct. 2017.

[8] S. Dazeley, A. Bernstein, T. Classen, E. Reedy, **D. Hellfeld**, M. Duvall, and C. Marianno, "Antineutrino Detection based on ^{6}Li-doped Pulse Shape Sensitive Plastic Scintillator and Gd-doped Water," *in Proc. Int. Conf. App. Nucl. Tech.*, Crete, Greece, Jun. 2017.

[9] **D. Hellfeld**, S. Dazeley, A. Bernstein, and C. Marianno, "Reconstructing the Direction of Reactor Antineutrinos via Electron Scattering in Gd-Doped Water Cherenkov Detectors," *Nucl. Instrum. Meth. A*, vol. 841, pp. 130–138, Jan. 2017.

[10] **D. Hellfeld**, P. Barton, D. Gunter, L. Mihailescu, and K. Vetter, "Optimization of a Spherical Active Coded Mask Imager," *in Proc. IEEE NSS-MIC*, Strasbourg, France, Nov. 2016.

[11] N. S. Bowden, K. M. Heeger, P. Huber, C. Mariani, and R. B. Vogelaar, "Applied Antineutrino Physics - Conference Summary," *arXiv:1602.04759*, Arlington, VA, Dec. 2015.

[12] **D. Hellfeld**, A. Bernstein, S. Dazeley, and C. Marianno, "Nuclear Reactor Antineutrino Directionality via Elastic Electron Scattering in a Gd-Doped Water Cherenkov Detector," *in Proc. INMM Annual Meeting*, Indian Wells, CA, Jul. 2015.

[13] **D. Hellfeld**, "Feasibility of Nuclear Reactor Antineutrino Directionality via Elastic Electron Scattering in the WATer CHerenkov Monitor of ANtineutrinos (WATCHMAN)," Master's thesis, Texas A&M University, May 2015.

[14] A. Bernstein and the WATCHMAN collaboration, "The Physics and Nuclear Nonproliferation Goals of WATCHMAN: A WATer CHerenkov Monitor for ANtineutrinos," *arXiv:1502.01132*, Feb. 2015.

REFERENCES *Available upon request.*