

# Daniel C. Elton

## EDUCATION

*Ph.D.*, Physics  
Stony Brook University, Stony Brook, NY Dec. 2016

*Bachelor of Science*, Physics  
Rensselaer Polytechnic Institute, Troy, NY Aug. 2009  
GPA 3.87

## PROFESSIONAL EXPERIENCE

*Data Science Office, Massachusetts General Hospital, Boston, MA*  
Data Scientist Jul 2021 -  
Working for Dr. Christopher Bridge on the machine learning team.

- Deployed multiple AI systems for testing in the radiology clinic, working closely with clinicians, software engineers, and industry partners.
- Worked on anomaly detection and monitoring systems for medical AI safety.
- Developed deep learning models for kidney stone detection and image classification.

*National Institutes of Health, Bethesda, MD*  
Staff Scientist Jan 2019 - Jul 2021  
Contractor supervised by Dr. Ronald M. Summers at the NIH Clinical Center, Department of Radiology and Imaging Sciences.

- Developed a deep learning based system for kidney stone detection and size quantification on CT scans which achieved state-of-the-art performance on a challenging test set of noisy CT scans.
- Developed a patch-based 3D U-Net for segmentation of plaque in the aorta and pelvic arteries. The system produced plaque Agatston scores that correlated well with manual measurements ( $r^2 = 0.94$ ) on a large external test set.
- Trained a 3D U-Net ensemble for pancreas segmentation using an active learning approach which achieved state-of-the-art performance on non-contrast CT. Ran the model on  $\approx 20,000$  scans for 9,000 patients to correlate pancreas features with diabetes diagnosis.
- Developed a deep learning based system for bone mineral density measurement in CT scans which utilizes an iterative instance algorithm to segment and label the entire spine.
- Constructed a large dataset of  $\approx 20,000$  MRI scans and bookmarked annotations which is being used for machine learning endeavours in the lab. Worked on registration of different MRI series.
- Made numerous improvements to NIH C++ codes for automated bone mineral density measurement, fat measurement, and fracture detection and tested algorithms on a variety of CT scan types.
- Trained and tested U-Net based models for pancreas segmentation, spleen segmentation, liver vessel segmentation, liver region segmentation, and segmentation of vesicles in electron microscope images.
- Helped develop and test CycleGAN and UNIT image translation models for CT data augmentation for deep learning (contrast to synthetic non-contrast conversion).
- Performed GPU server installation, maintenance, and backups. Worked with a team from Blackford Analysis to deploy AI tools from Dr. Summers' lab into the radiology clinic at NIH.
- Supervised and mentored a post-baccalaureate fellow (Hima Tallam, August 2020 - June 2021) and three summer interns.

*University of Maryland, College Park, MD*  
Postdoctoral Researcher March 2017 – Dec 2019  
Supervised by Prof. Peter W. Chung and Prof. Mark Fuge.

- Demonstrated for the first time how machine learning models can predict the properties of propellants & explosives with high accuracy.
- Developed a natural language processing pipeline to extract chemical names, properties, and applications from large corpora of text extracted from PDFs and patent applications.
- Supervised a masters student (Dhruv Turakhia) and an undergraduate student (Nischal Reddy Chandra) who contributed to the NLP project.
- Explained the utility of machine learning methods to program managers and chemists in DoD research labs by participating in numerous talks and discussions. Wrote a four page white paper grant proposal.
- Explored how sensitivity analysis of machine learning models and feature ranking techniques can be used to help illuminate possible relationships between molecular structures and properties.
- Wrote a review article on deep learning techniques for molecular design and demonstrated how a generative adversarial network can be used to generate sets of potentially useful molecules.

*Stony Brook University, Stony Brook, NY*

Graduate Research Assistant

June 2012 – December 2016

Ph.D. adviser: Prof. Marivi Fernández-Serra. Thesis: *Understanding the Dielectric Properties of Water*.

- Wrote a Fortran code (*PIMD-F90*) for simulation of nuclear quantum effects in liquid water and a Python package (*spectrumfitter*) for fitting dielectric spectra. Parallelized code with MPI and ran large scale molecular dynamics simulations on HPC clusters.
- Planned and executed a detailed simulation study of the dielectric properties of water which led to the discovery of optical phonon-like modes in liquid water.

Graduate Teaching Assistant

September 2010 - May 2012

*Los Alamos National Laboratory, Los Alamos, NM*

Science Undergraduate Laboratory Internship

June – August 2010

- Worked with Dr. Garrett Kenyon on biologically-inspired neural networks for computer vision.

## COMPUTER SKILLS

- My primary programming language is Python. I have extensive past experience with Matlab and Fortran and some recent experience with C++ and C#.
- Python libraries: pytorch, tensorflow, keras, scikit-learn, pandas, numpy, matplotlib.
- git, Docker, L<sup>A</sup>T<sub>E</sub>X, GNU/Linux, slurm, bash, 3D Slicer, POV-Ray

## PEER REVIEWED JOURNAL ARTICLES

- S. Lee, **D. C. Elton**, A. Yang, C. Koh, D. Kleiner, P.J. Pickhardt, R. M. Summers. “Fully-automated Liver Couinaud and Spleen Segmentation in CT for Diagnosing Liver Cirrhosis and Advanced Fibrosis”. *Radiology: Artificial Intelligence*. **4** (5) pgs e210268, 2022
- Note: I did all of the deep learning work for this paper.
- D. C. Elton**, E. B. Turkbey, P. J. Pickhardt, R. M. Summers. “A deep learning system for automated kidney stone detection and volumetric segmentation on non-contrast CT scans”. *Medical Physics*, **49** (4) pgs 2545-2554, 2022.
- H. B. Tallam, **D. C. Elton**, S. Lee, P. Wakim, R. M. Summers. “Fully-automated Abdominal CT Imaging Biomarkers for Type 2 Diabetes using Deep Learning”. to appear in *Radiology*, **304** (1), pgs 85-95, 2022.
- Note: I did all of the deep learning work for this paper.
- S. Lee, **D. C. Elton**, J. L. Gulley, P. J. Pickhardt, W. L. Dahut, R. A. Madan, P. A. Pinto, D. E. Citrin, R. M. Summers. “Assessment of aortoiliac atherosclerotic plaque on CT in prostate cancer patients undergoing treatment.” *Tomography* **8** (2) pgs 607–6, 2022.

- S. Wang, Y. Zhu, S. Lee, **D. C. Elton**, T. Shen, Y. Tang, Y. Peng, Z. Lu, R. M. Summers. “Global-Local Attention Network with Multi-task Uncertainty Loss for Abnormal Lymph Node Detection in MR Images”. *Medical Image Analysis*, **77**, pg 102345, 2022.
- A. A. Perez, V. Noe-Kim, M. G. Lubner, P. M. Graffy, J. W. Garrett, **D. C. Elton**, R. M. Summers, P. J. Pickhardt. “Automated Deep Learning CT-based Liver Volume Segmentation: Defining Normal and Hepatomegaly for Clinical Practice.” *Radiology*, **302** (2) pgs 336-342. 2021.
- P. J. Pickhardt, P. M. Graffy, A. A. Perez, M. G. Lubner, **D. C. Elton**, R. M. Summers. ‘Opportunistic Screening at Abdominal CT: Use of Automated Body Composition Biomarkers for Added Cardiometabolic Value’. *Radiographics*, **41**(2), 524-542, 2021.
- D. C. Elton**. “Applying Deutsch’s concept of good explanations to artificial intelligence and neuroscience - an initial exploration”. *Cognitive Systems Research*, **67**, 9, 2021.
- P. J. Pickhardt, G. Blake, P. M. Graffy, V. Sandfort, **D. C. Elton**, A. A. Perez, R. M. Summers. “Liver Steatosis Categorization on Contrast-Enhanced CT Using a Fully-Automated Deep Learning Volumetric Segmentation Tool: Evaluation in 1,204 Healthy Adults Using Unenhanced CT as Reference Standard”, *American Journal of Roentgenology*, **217**(2), 359-367, 2020.
- P. M. Graffy, P. J. Pickhardt, **D. C. Elton**, S. J. Lee, J. Liu, V. Sandfort, R. M. Summers. “Fully-automated CT Imaging Biomarkers of Bone, Muscle, and Fat: Correcting for the Effect of Intravenous Contrast”, *Abdominal Radiology*, **46**, pgs 1229–1235, 2020.
- Note: I did nearly all of the deep learning work for this paper.
- R. M. Summers, **D. C. Elton**, S. Lee, Y. Zhu, J. Liu, M. Bagheri, V. Sanfort, P. C. Grayson, N. N. Mehta, P. A. Pinto, W. M. Linehan, A. A. Perez, P. M. Graffy, S. O’Connor, P. J. Pickhardt. “Atherosclerotic Plaque Burden on Abdominal CT: Automated Assessment with Deep Learning on Noncontrast and Contrast-enhanced Scans”, *Academic Radiology*, **28**(11), pgs 1491-1499, 2020.
- Note: I did all of the deep learning and most of the data analysis work for this paper.
- D. C. Elton**, P. D. Spencer, J. D. Riches, E. D. Williams. “Exclusion zone phenomena in water - a critical review of experimental findings and theories”, *International Journal of Molecular Sciences*, **21** (14), 5041, 2020.
- D. C. Elton**, Z. Boukouvalas, M. D. Fuge, and P. W. Chung. “Deep learning for molecular design - a review of the state of the art”, *Molecular Systems Design & Engineering*, **4**, 828, 2019.
- G. Kumar, F. G. VanGessel, **D. C. Elton**, and P. W. Chung. “Phonon Lifetimes and Thermal Conductivity of the Molecular Crystal  $\alpha$ -RDX”, *MRS Advances*, **4**, 2191, 2019.
- D. C. Elton**, M. Fritz, and M.-V. Fernández-Serra, “Using a monomer potential energy surface to perform approximate path integral molecular dynamics simulation of ab-initio water at near-zero added cost”, *Phys. Chem. Chem. Phys.*, **21**, 409, 2019.
- D. C. Elton**, Z. Boukouvalas, M. S. Butrico, M. D. Fuge, and P. W. Chung, “Applying machine learning techniques to predict the properties of energetic materials”, *Scientific Reports* **8**, 9059, 2018.
- D. C. Elton** “The origin of the Debye relaxation in liquid water and fitting the high frequency excess response”, *Phys. Chem. Chem. Phys.*, **19**, 18739, 2017.
- D. C. Elton** and M.-V. Fernández-Serra, “The hydrogen-bond network of water supports propagating optical phonon-like modes”, *Nature Communications*, **7**, 10193, 2016.
- D. C. Elton** and M.-V. Fernández-Serra, “Polar nanoregions in water - a study of the dielectric properties of TIP4P/2005, TIP4P/2005f and TTM3F”, *The Journal of Chemical Physics*, **140**, 124504, 2014.
- J. J. Podesta, M. A. Forman, C. W. Smith, **D. C. Elton**, and Y. Malecot, “Accurate Estimation of Third-Order Moments from Turbulence Measurements”, *Nonlin. Proc. Geophys*, **16**, 99, 2009.

#### PEER REVIEWED CONFERENCE PAPERS

- D. C. Elton**, A. Chen, P. J. Pickhardt, R. M. Summers. “Cardiovascular disease and all-cause mortality risk prediction from abdominal CT using deep learning”. *To appear in proceedings of SPIE Medical Imaging 2022: Computer-Aided Diagnosis*. (2021)
- Tejas S. Mathai, S. Lee, **D. C. Elton**, Tommy Shen, R. M. Summers. “Lymph node detection in T2 MRI with transformers”. *To appear in proceedings of SPIE Medical Imaging 2022: Computer-Aided Diagnosis*. (2022)

- Y. Zhu, S. Wang, S. Lee, Q. Chen, **D. C. Elton**, T. Shen, Y. Tang, Z. Lu, R. M. Summers. “Learning Structured Graphs from Visual/Semantic Feature and Radiology Ontology Graph for Lymph Node Classification”. *To appear in the Proceedings of the 2021 Machine Learning in Medical Imaging (MLMI) MICCAI workshop*.
- D. C. Elton**. “Common pitfalls when explaining AI and why mechanistic explanation is a hard problem”. *to appear in Proceedings of the 6th International Congress on Information and Communication Technology*, 2021.
- Y. Peng, S. Lee, **D. C. Elton**, T. Shen, Y. Tang, Q. Chen, S. Wang, Y. Zhu, R. M. Summers, Z. Lu “Automatic recognition of lymph nodes from clinical text”. *Proceedings of the 3rd Workshop on Clinical Natural Language Processing (ClinicalNLP)*, 101-110, 2020.
- S. Y. Shin, S. Lee, **D. C. Elton**, J. Gulley, R. M. Summers. “Deep Small Bowel Segmentation with Cylindrical Topological Constraints”, *Medical Image Computing and Computer Assisted Intervention (MICCAI) 2020*, edited by Anne L. Martel et al., Springer International Publishing, **12264**, 207–15.
- Y. Zhu, Y. Tang, Y. Tang, **D. C. Elton**, S. Lee, P. J. Pickhardt, R. M. Summers. “Cross-Domain Medical Image Translation by Shared Latent Gaussian Mixture Model”, *Medical Image Computing and Computer Assisted Intervention (MICCAI) 2020*, edited by Anne L. Martel et al., Springer International Publishing, **12262**, 379–389, 2020.
- Z. Boukouvalas, M. Puerto, **D. C. Elton**, P. W. Chung, M. D. Fuge. “Independent Vector Analysis for Molecular Data Fusion: Application to Property Prediction and Knowledge Discovery of Energetic Materials”, *Proceedings of the 28th European Signal Processing Conference (EUSIPCO)*, 2020.
- D. C. Elton**. “Self-explaining AI as an alternative to interpretable AI”, *Proceedings of the 13th Annual Conference on Artificial General Intelligence*, pg. 95, 2020.
- Y. Zhu, **D. C. Elton**, S. Lee, P. J. Pickhardt, R. M. Summers. “Image Translation by Latent Union of Subspaces for Cross-Domain Plaque Detection”, *Proceedings of the International Conference on Medical Imaging with Deep Learning (MIDL)*, 2020.
- D. C. Elton**, V. Sandfort, P. J. Pickhardt, R. M. Summers. “Accurately identifying vertebral levels in large datasets”, *Proceedings of SPIE: Medical Imaging: Computer-Aided Diagnosis, 1131400*, 2020.
- D. C. Elton**, D. Turakhia, N. Reddy, Z. Boukouvalas, R. M. Doherty, M. D. Fuge, and P. W. Chung. “Using natural language processing techniques to extract information on the properties and functionalities of energetic materials from large text corpora”, *Proceedings of the 22nd International Seminar on New Trends in Research of Energetic Materials*, 2019.
- Z. Boukouvalas, **D. C. Elton**, M. D. Fuge, and P. W. Chung. “Independent Vector Analysis for Data Fusion Prior to Molecular Property Prediction with Machine Learning”, *2018 Neural Information Processing Systems (NeurIPS) workshop on Machine Learning for Molecules and Materials*, 2018.
- B. C. Barnes, **D. C. Elton**, Z. Boukouvalas, D. E. Taylor, W. D. Mattson, M. D. Fuge, and P. W. Chung, “Machine Learning of Energetic Material Properties”, *Proceedings of the 16th International Detonation Symposium, Cambridge MD*, 2018.
- F. G. VanGessel, G. Kumar, **D. C. Elton**, and P. W. Chung, “A Phonon Boltzmann Study of Microscale Thermal Transport in  $\alpha$ -RDX Cook-Off”, *Proceedings of the 16th International Detonation Symposium, Cambridge MD*, 2018.
- M. A. Forman, C. W. Smith, B. J. Vasquez, B. T. MacBride, J. E. Stawarz, J. J. Podesta, **D. C. Elton**, U. Y. Malecot, and Y. Gagne. “Using Third-Order Moments of Fluctuations in V and B to Determine Turbulent Heating Rates in the Solar Wind”, *AIP Conference Proceedings, 12th International Solar Wind Conference*, **1216**, 176, 2009.

#### PEER REVIEWED BOOK CHAPTERS

- D. C. Elton** and P. D. Spencer. “Four examples of pathological water science and what they have in common”. *Water in Biomechanical & Related Systems*, A. Gadomski, editor. Springer, Cham. pg 155, 2021.

#### HONORS

NIH Future Research Leaders Conference participant, 2021  
 NIH Kelly Government Solutions Distinguished Achievement Award, 2020, 2021

Foresight Institute Foresight Fellow in Artificial Intelligence, 2020  
Talent, MindFire Mission-1, 2018  
Peter B. Kahn travel prize, Stony Brook University Physics Department, 2014  
Rensselaer Founder's Award of Excellence, 2009  
Sigma Pi Sigma, 2008  
Rensselaer Medal/Scholarship, 2006  
Willits Foundation Scholarship, 2006  
RIT Computing Award/Scholarship, 2006  
National Merit Scholarship Finalist, 2006

## TALKS

- "Fully Automated CT Biomarkers for Risk Prediction using Deep Learning". International Conference on Medical Imaging Science and Technology, Online. 2 December 2021.
- "Applying Deutsch's concept of good explanations to artificial intelligence and neuroscience - an initial exploration", Biologically Inspired Cognitive Architectures (BICA) conference, Online. 10 November 2020.
- "Why self-explanation and applicability domain analysis are key to building more robust and trustworthy AI systems", INFORMS 2020 Conference, Online. 13 November 2020.
- "Pitfalls with explainability techniques and self-explaining AI as a possible remedy", Foresight Institute Salon on "Key issues in near-term AI Safety research", Online. 7 July 2020.
- "Self-explaining AI as an alternative to interpretable AI", Artificial General Intelligence Conference, Online. 24 June 2020.
- "AI for medical imaging", TAFFD's International Conference on Future Africa, Online. 22 April 2020.
- "Accurately identifying vertebral levels in large datasets", SPIE: Medical Imaging Conference, Houston, Texas. 17 February 2020.
- "Societal, Policy, and Regulatory Implications of AI for Healthcare and Medicine", Envision Conference, Princeton University, Princeton, New Jersey. 23 November 2019.
- "Introduction to machine learning topics : optimization techniques and convolutional neural networks", Deep Learning RIT (Research Interaction Team), UMD Mathematics Department, College Park, MD. 21 September 2018.
- "Machine learning and AI for navy energetics", Talk to SEAP interns from Indian Head Naval Surface Warfare Center, College Park, MD. 2 August 2018.
- "Machine learning for design and discovery of new energetic materials", Broad Institute Seminar, Cambridge, Massachusetts. 7 June 2018.
- "Machine learning for design and discovery of new energetic materials", Gordon Research Seminar - Advances in Modeling, Experimental Developments and Synthesis of Energetic Materials, Newry, Maine. 3 July 2018.
- "Machine learning of energetic molecule performance", Army Research Laboratory, Aberdeen, MD. 20 April 2018.
- "Pitfalls of machine learning", Artificial Intelligence Information Meetup, Silver Spring, MD. 21 February 2018.
- "Pitfalls and biases in machine learning", Bellevue Machine Learning & Artificial Intelligence Meetup, Bellevue, WA. 10 February 2018.
- "Machine learning pitfalls", Tech Valley Machine Learning Meetup, Troy, NY. 28 December 2017. 28 December 2017.
- "Interpretable machine learning for molecular design and discovery", Tech Valley Machine Learning Meetup, Troy, NY. 20 November 2017.

- “Scikit-learn & Keras applied to digit recognition”, Tech Valley Machine Learning Meetup, Troy, NY. 12 February 2016.
- “Accurate path integral molecular dynamics simulation of ab-initio water at near-zero added cost”. American Physical Society March Meeting, Baltimore, MD. 3 March 2016.
- “Propagating optical phonon-like modes in liquid water”, Institute for Advanced Computational Science, Stony Brook University. 3 February 2016.
- “Propagating optical phonon-like modes in liquid water”, Young Researcher Symposium, Brookhaven National Lab. 27 November 2015.
- “Exploring the nonlocal dielectric susceptibility of liquid water in the terahertz regime - propagating modes, Debye relaxation, and overscreening”, American Physical Society March Meeting, San Antonio, Texas. 2 March 2015.
- “Water - a relaxor ferroelectric?”, Gordon Research Seminar - Water & Aqueous Solutions, Holderness, NH. 26 July 2014.
- “Water - a relaxor ferroelectric?”, Graduate Student Friday Afternoon Seminar, Stony Brook University, Stony Brook, NY.
- “Polar nanoregions in water - a study of the dielectric properties of TIP4P/2005, TIP4P2005f and TTM3F”, American Physical Society March Meeting, Denver, Colorado. 5 March 2014.

## REFERENCES

Dr. Ronald M. Summers, rsummers@cc.nih.gov, 301-402-5486  
Prof. Peter W. Chung, pchung15@umd.edu, 301-405-4543  
Prof. Mark D. Fuge, fuge@umd.edu, 301-405-2558