Daniel O'Connor

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Google Scholar • Stack Exchange • GitHub

Applied mathematician and Associate Professor with expertise in convex optimization, machine learning, computer vision, medical physics and hands-on experience developing numerical algorithms to solve real-world problems in the academic, medical and defense sectors.

Employment

University of San Francisco, Dept. of Mathematics and Statistics

Associate Professor (with tenure) — *2024-Present*
Assistant Professor (tenure-track) — *2018-2024*
Director, Bachelor of Science in Data Science program — *2020-Present*

- Revamped machine learning curriculum to emphasize deep learning, starting with logistic regression coded from scratch.
- Mentored Data Science graduate students working on industry practicum projects (such as deep learning-based image segmentation and anatomical keypoint detection in optical coherence tomography images for Gore Medical).
- In consultation for Gore Medical, greatly improved medical image edge detection results despite shortage of training data by implementing U-Nets with pretrained ResNet or VGG16 encoders. (Some results are shown here.)

UCLA, Dept. of Radiation Oncology

Postdoctoral Fellow (Optimization Algorithms for Medical Physics Applications) — *2015–2018*

- Developed a breakthrough beam orientation optimization algorithm for non-coplanar IMRT that became the centerpiece of startup Celestial Oncology's software stack. The algorithm was 10x faster than competing algorithms, without sacrificing dosimetric quality. Implemented versions in Matlab, Python, and C++.
- Coauthored 16 journal publications. Regularly presented research at AAPM annual conferences.

RefleXion Medical

Research Intern (Treatment Planning Algorithms) — *Summer 2015*

- Created RefleXion's fluence map optimization engine, a key piece of RefleXion's software stack. My algorithms contributed to a successful Series B funding effort ($52 million). Delivered an AAPM 2016 oral presentation based on this work.

Celestial Oncology

Optimization Algorithm Consultant — *Summer 2023*

- Added core functionality to Celestial's treatment planning system by devising and coding a novel strategy to enforce challenging non-convex constraints (dose-volume constraints) which arise in radiation therapy. Also wrote code to enforce mean-dose constraints, and tracked down and fixed a bug which Celestial engineers had been observing.

UCLA, Dept. of Mathematics

Graduate Student Researcher (Convex Optimization) — *2011–2015*

- Research on large scale optimization algorithms led to four journal publications, including first-author publications in *SIAM Journal on Imaging Sciences* (with 70+ citations) and *Computational Optimization and Applications*.
- TAed for graduate-level Convex Optimization courses (specifically Vandenberghe's popular course EE236b).

UCLA Computer Vision Lab

Research Assistant — *2009–2010*

- Developed a state-of-the-art semi-supervised video segmentation algorithm which was highlighted in lab grant applications.

Areté Associates

Research Analyst (Data Science & Algorithm Development) — *2006–2009*

- Wrote code base and played a lead role in algorithm development for a project to determine the velocities of river currents from airborne imagery. This work led to a $3 million contract to create and field a working system.
- Advanced Areté's capabilities in computer vision-based 3D scene understanding, implementing multiple view geometry (structure from motion) algorithms and writing OpenGL code in C++ to reconstruct and visualize models of 3D scenes. My implementation of the sparse Levenberg-Marquardt algorithm for bundle adjustment can be found here.

Education

PhD, Mathematics *University of California, Los Angeles*
Thesis topic: Primal-dual operator splitting methods for convex optimization. (Advisor: L. Vandenberghe)

B.S., Mathematics (with honors) *University of Texas, Austin*

Programming languages

- Languages: Python, SQL, C++, Matlab, IDL, LaTeX
- Related libraries: PyTorch, NumPy, SciPy, Matplotlib, Pandas, Scikit-Learn, Flask, CVXOPT

Selected publications

- **D. O'Connor**, V. Yu, D. Nguyen, D. Ruan, and K. Sheng, "Fraction-variant Beam Orientation Optimization for Non-coplanar IMRT." *Physics in Medicine & Biology*, 2018. (29 citations)
- **D. O'Connor** and L. Vandenberghe, "On the Equivalence of the Primal-Dual Hybrid Gradient Method and Douglas-Rachford Splitting." *Mathematical Programming*, 2018. (75 citations)
- W. Gu, **D. O'Connor**, D. Nguyen, V. Yu, D. Ruan, and K. Sheng, "Integrated beam orientation and scanning-spot optimization in intensity-modulated proton therapy for brain and unilateral head and neck tumors." *Medical Physics*, 2018. (76 citations)
- **D. O'Connor** and L. Vandenberghe, "Total Variation Image Deblurring with Space-varying Kernel." *Computational Optimization and Applications*, 2017. (17 citations)
- **D. O'Connor** and L. Vandenberghe, "Primal-dual Decomposition by Operator Splitting and Applications to Image Deblurring." *SIAM Journal on Imaging Sciences*, 2014. (74 citations)